The Dissertation Committee for Alejandra Elisa Ramírez Cuesta Certifies that this is the approved version of the following dissertation:

THE SOCIAL GEOGRAPHY OF INDUSTRIAL POLLUTION

IN THE METROPOLITAN AREA OF BUENOS AIRES

Committee:

Peter M Ward, Supervisor

Robert H Wilson

Bryan R Roberts

Javier Auyero

Jennifer A Miller

Shama Gamkhar

THE SOCIAL GEOGRAPHY OF INDUSTRIAL POLLUTION

IN THE METROPOLITAN AREA OF BUENOS AIRES

by

Alejandra Elisa Ramírez Cuesta, B. Arch.; M.A.

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

December 2012

Dedication

To my husband and my children,

Daniel, Victoria, Sofía and Martin.

Acknowledgements

This dissertation is a culmination of a long journey that involved many people who in different manners helped and encouraged me to complete this research. I will be always extremely grateful for their support. Here, I would like to express my gratitude to some of them, and I apologize for those that I may have unintentionally overlooked.

This research would have not be possible without the support and guidance of my committee members Peter Ward, Bob Wilson, Jennifer Miller, Bryan Roberts, Javier Auyero, Shama Gamkhar and many other professors at the LBJ that in different manners contributed to my intellectual grow. In particular, I am deeply grateful to my advisor Peter Ward for his commitment, support and patience. Throughout all these years in the PhD program and specially while conducting this research, he encouraged and challenged me intellectually to refine my research interest. I was very fortunate to work with him as a research assistant and teaching assistant, and to participate with him in the Latin American Housing Network. His passion for what he does was an inspiration for me. I will always be thankful to Bob for being my mentor during my first years in the program and for encouraging me to explore different perspectives on urban analysis and for introducing me to the world of statistics. I would also like to give special thanks to Jennifer who led me through the spatial analysis; without her support I couldn't have conducted the quantitative analysis of this dissertation. Finally, I would like to thank

Bryan and Javier for providing me with different perspectives of analyses; their comments enriched this work.

My doctoral studies were made possible through a number of donors, my gratitude to all of them. The LBJ School of Public Affairs provided me funding during the time I lived in Austin. The Teresa Lozano Long Institute of Latin American Studies provided me funding to conduct my field research in Buenos Aires through the Faculty Sponsored Dissertation Research Grant Field Research in Latin America and Lozano Long Travel Grant. Finally the Susan Hadden Felloship provided me the necessary finding to conclude this dissertation.

A great part of this study also was possible thanks to many colleagues and friends that help me to conduct my field research in Buenos Aires. Thanks to Cecilia Larivera, Leonardo Fernández, Máximo Lanzetta, Mora Arauz, Freddy Garay and all the people that kindly participate in the interviews. Thanks to all of you for your time and support. I also would like to thank to my old friends from Argentina Viviana Scagnoli, Pablo Peyrano, Daniel Sadino and Omar Odarda that help me in many ways to finish this dissertation.

My sincere gratitude goes to all my colleagues and friends who shared my academic life at UT. My cohort deserves an especial mention: Laura Spagnolo and Sofia Ayala ("Big Sofia"). Throughout all these years, we shared all the professional and personal challenges that imply to conduct a PhD. You girls were for me (and my family) my extended family in Austin. Laura, I thank you for your pragmatism and optimism during my times of doubt. My dear "Big Sofia", there are not enough words for everything you have done for me and my kids, you always were there no matter what, and you cannot imagine what that meant for me. During these years at UT I met many amazing people with whom I shared beautiful moments, long academic discussions and from whom I learned a lot: Carolina Flores, Lissette Aliaga, Greg Landreth, Sebastian Valenzuela, Teresa Correa, Viviana Salinas, Eunice Vargas, Jonas De Basabe, Sonia Frías, Denisse Gelber, Erika Grajeda, Maria Garcia, Cristina Saborio, Suzanne Mathews and Maria Luisa Echevarria. Thanks to all of you.

I have been very fortunate to share the UT experience with the amazing community of Brackenridge students' apartments. My friends in Brackenridge made me (and my family) feel that Austin was home; thanks to Javier Pereira, Flavia Previtali, Mariana Montoya, Jorge Puertas, Emilia Arce, Marcelo Campos, Carlos Barrera, Meghan Dinnan, Jude and Ty Bricker, Daniela Torres, Pablo Gentil, Regina Aguilar, Patricia Murrieta and all their kids. I will never forget the wonderful time we had there: the barbecues, the time we spent drinking 'mate' at the playground and the shared experience of being a graduate student with kids. I also would like to thanks to the community of Mathews Elementary, Ms. Kinkade, all the teachers and the staff, and to the Early Educational Center of the University United Methodist Church for taking care of my children and giving them the sense of belonging to a community. These amazing institutions provided a beautiful environment for my kids and taught them important values that we will take with us forever.

Last but not least, I would like to express my enormous gratitude to my family, especially my kids and my husband. To my father, mother-in-law and sister for helping take care of my kids during different phases of my studies, and for always being supportive. To my kids: Victoria, Sofia and Martin that gave me the strength I needed to conduct and finish my PhD. To Victoria for showing me that the tough questions need to be answered with clear foundations, to Sofia for always making me laugh even when I was not in the mood and to Martin for always holding my hand. Finally to my most critical reader, my husband Daniel, you always encouraged me to take another step in all aspects of life, without your support and love couldn't have come this far. I love you.

THE SOCIAL GEOGRAPHY OF INDUSTRIAL POLLUTION IN THE METROPOLITAN AREA OF BUENOS AIRES

Alejandra Elisa Ramírez Cuesta, PhD.
The University of Texas at Austin, 2012

Supervisor: Peter M Ward

The purpose of this study is to investigate the driving factors of population exposure to sources of environmental pollution and to determine if poor neighborhoods are disproportionately exposed to negative environmental externalities. This research also examines whether the concentration of polluting industries within neighborhoods of different socio-economic levels varies over time.

To determine the causes of the spatial coincidence between population and industrial polluters, this study employs a mixed-methods approach. Quantitatively, this study uses an exploratory approach to capture the effects of poverty and segregation on the density of hazardous industries. This methodological approach models the spatial variation of the relationship between poverty and pollution. Qualitatively, a cross-case comparative analysis is conducted on two different socio-economic neighborhoods to trace the causes of continuity or change in industrial density.

The study finds that polluting industries tend to be distributed homogenously across neighborhoods of different socio-economic backgrounds and that poverty and

segregation are not mayor drivers of that distribution. On the contrary, the relationship between poor and segregated and industries presents spatial variation and it is localized in some specific areas. The case-studies comparison, moreover, indicates that the spatial concentration of hazardous industries varies over time, decreasing slightly in a middle-class neighborhood and increasing in a poor neighborhood. This is explained by: i) economic constraints and opportunities to the local economy determine the permanence of polluting activities; ii) middle-class collective actions to live in a better environment contribute to expel polluting activities from the neighborhood in the long run; and iii), local political practices and the lack of alternatives and resources to access the formal land market means that the poor face tremendous environmental burdens which traps them in a noxious environment.

Several policy implications arise from this research; first, access to information, transparency, and environmental law enforcement must be strengthened in order to underpin equity and common standards across the city. Second, local governments should weigh and balance the need for housing and development, and the environmental consequences when establishing zoning ordinances. Third, policies and resources should be targeted towards residents, especially those poorer residents that are most at risk.

Table of Contents

List of Tables

List of Figures

List of Maps

List of Acronyms

AIC	Akaike Information Criterion
AMBA	Area Metropolitana de Buenos Aires
CABA	Ciudad Autónoma de Buenos Aires
C2	Industries Category 2
C3	Industries Category 3
C 2 3	Industries Category 2 and 3
DC3	Industrial Density Category 3
DC2&3	Industrial Density Category 2 and 3
GBA	Gran Buenos Aires
GWR	Geographically Weighted Regression
IMPH	Indice Material de Privación de los Hogares (Households' material deprivation Index)
ISI	Import Substitution Industrialization
LULU's	Local Undesirable Land Uses
NCA	Level of environmental complexity defined by the regulation
N-S	Non-stationarity
MAUP	Modifiable Areal Unit Problem
OLS	Ordinary Least Square (regression)
RMBA	Región Metropolitana de Buenos Aires

CHAPTER 1

INTRODUCTION

This study explores the spatial outcomes of urban environmental pollution, by addressing the relationship between industrial sources of environmental pollution and the urban population in the Metropolitan Area of Buenos Aires (AMBA). This research aims to understand the processes and factors that shape this relationship. To do so it addresses the metropolitan dynamics and spatial variation in the distribution of stationary sources of environmental pollution and the processes and causal mechanisms that drive the concentration of polluting facilities and the consolidation of residential areas. Moreover, based on case study analysis this research analyzes whether the relationship between sources of industrial pollution and different socio-economic sectors deepens or changes over time, and the causes of change.

This introductory chapter frames the general approach of this dissertation and discusses the relevance of this research. It first introduces three dimensions of the urban environment that make this study especially relevant and include the sources of environmental pollution, the health effects of pollution, and the social dimension. Second, it offers a general overview of the urban environmental problems faced in Latin American (LA) cities and in the AMBA. Third, it presents the main objectives and research contributions of this research. Finally, it provides a general overview of the dissertation.

DIMENSIONS OF THE URBAN ENVIRONMENT

To understand the relevance of the urban environmental problems, specifically those related to environmental hazards, it is necessary to consider three main aspects. These are the type of source of emission, the health impacts, and the social context of pollution. The type, concentration and distribution of polluters define the spatial extent of their impact and the exposure pathway. The characteristics of the urban environment in which they occurred have a direct impact on the population's health. Different socio-economic sectors can face similar levels of pollution, but the possibilities to cope with environmental externalities are shaped by their social characteristics (Kreig and Faber 2004). In this sense, the poor's limited resources make them especially vulnerable to environmental pollution. The confluence of these factors makes relevant the study of environmental inequalities in urban settings relevant.

i) The latent threat of stationary sources of pollution in the urban context.

Outdoor air pollution is caused predominantly by the combustion of non-renewable fuels for electricity generation, transportation and industry (World Health Organization 2005). Among the sources of environmental pollution, the literature distinguishes between stationary and non-stationary sources. Stationary sources refer to non-moving sources, fixed-site producers of pollution such as industrial uses, waste facilities and electrical plants. The non-stationary refers to mobile sources of pollution, such as transportation and cars. Unlike stationary sources, these sources move across the space, having a greater dispersed or a broader impact in the territory. The dimension and the severity of these sources' impact depend upon the level of emission and a city specific characteristics and geographic context.

Stationary sources of pollution have important implications for the urban environment in general, yet they possess localized effects to the population living in proximity to those facilities. Considering the different 'exposure pathways', these sources put important threats to the population living near these facilities since the potential physical contact with polluted soil, water and air contaminants makes these population more vulnerable (Agency for toxic substance and diseases registry 2005).[1] Even though there are some differences in the academic literature, proximity to a toxic release is associated with potential exposure to hazardous substances and, therefore, potential health risks (Pastor, Sadd, and Morello-Frosch 2004; Perlin, Setzer, Creason, and Sexton 1995; Pollock and Vittas 1995). Furthermore, living in close proximity to polluting sites is most likely to be exposed over time (Agency for toxic substance and diseases registry 2005). Different studies show that population living near these facilities/sites suffer from noxious health effects, for example: residential proximity to toxic waste sites may be associated with an increase in the risk for bearing children with congenital malformations (Geschwind and et al. 1992).

ii) Epidemiological transition in the urban environment. The health and epidemiological literature acknowledges the interrelation between the urban environment and a population's health. Far from being static, this relationship changes over time and varies according to the specific urban context. Urban environmental problems go through a series of changes that are represented as a series of stages that go from an initial phase

[1] The literature on environmental health considers 'exposure pathways' in order to determine and evaluate how people came into contact with pollutants. The *"exposure pathway is a link between environmental releases and local population that might come into contact with, or exposed to, environmental contaminants"* (ATDSR 2005, Chapter 6, p. 2). Evaluating exposure to environmental pollutants is a complex process that involves origin of environmental contamination, environmental fate and transport (type of transport media: e.g. air, water, soil, etc. and fate: mobility and degradation of the contaminants), area of exposure (the location where people get contact with pollutants), exposure route (e.g. by inhalation, ingestion, or physical contact) and potentially exposed population (ATDSR).

into a transition phase (Forsyth, Leach, and Scoones 1998). The initial phase occurs as a consequence of the lack of access to services. Inadequate sanitation, poor clean water supplies and waste disposal creates pathogenic hazards. From an epidemiological perspective, this stage is characterized by the existence of infectious diseases with a dominance of biological pathogens. In later stages, environmental problems are mainly related to sources of emission, such as industrial hazards (Forsyth, Leach, and Scoones 1998), and increases in private means of transportation. These changes have led to an epidemiological transition from infectious diseases to chronic diseases. This transition shifted the patterns of urban causes of death from infectious to chronic diseases (Stephens 1996). However, in urban environments pathogens and industrial hazards may exist at the same time (Forsyth, Leach, and Scoones 1998). In the specific case of Latin American cities these stages co-exist, creating a differentiated urban geography of hazards in which various areas present different levels and types of environmental problems.

iii) Social dimension. Cities in the developing world combine the traditional environmental health respiratory and enteric infections, with those associated with living conditions, poor housing quality, poor sanitation and water, polluted air and toxic wastes and unregulated industrialization (McMichael 2000). Environmental problems differ in type and scope within the cities, affecting in some cases specific social groups while in other cases the entire urban population (Clichevsky 2002). However, the literature argues that the urban poor face higher level of exposure to pollution (Hardoy, Mitlin, and Satterthwaite 1992; Kjellstrom, Friel, Dixon, Corvalan, Rehfuess, Campbell-Lendrum, Gore, and Bartram 2007; Lee 2002; Morello-Frosch, Pastor, and Sadd 2001; Stephens 1996).

Environmental risk and vulnerability encompass not only exposure, but also the socio-characteristics of the population. As Kreig and Faber (2004) state, identical hazards may pose radically different risks to the local population depending on the social context in which they exist (Kreig and Faber 2004). The combination of environmental hazards and the social context accentuates the vulnerability of certain neighborhoods and social groups with respect to others by affecting not only their quality of life, but also be limiting the opportunities that they have in economic and social terms(United Nations Environmental Program 2007).

Several factors shape the vulnerability of people and the environment like socio-economic characteristics, health, changing level of governance, technology and science. However, poverty represents a key dimension given the poor's lack of resources to respond and adapt to unfavorable environmental conditions (Hardoy, Mitlin, and Satterthwaite 1992; United Nations Environmental Program 2007). Poverty invariably constrains the poor to live in unsafe and polluted areas of the city (Bartone 2001; International Development Research Center 2005). The poor's higher vulnerability is reinforced by having deficit in access to public services, bad housing conditions, location in flooding and disaster prone areas, and proximity to hazardous sites.[2] Furthermore, low levels of income aggravate poverty depriving the poor to access to a safer environment by limiting their capability to improve the environment in which they live (Bartone 2001); consequently, the poor face a long-term exposure to pollution (Velez-Guerra 2005). In a downward spiral, poor environmental conditions aggravate poverty by having

[2] Vulnerability is defined as "an intrinsic feature of people at risk" and it is considered "a function of exposure (to hazards) sensitivity to impacts and the ability or lack of ability to cope or adapt"; it is also "multidimensional, multidisciplinary, multisectoral and dynamic" (UNEP, GEO-4, p. 304).

additional impacts: lower educational outcomes, loss of income and increased expenditure on health care (Bartone 2001).

URBAN ENVIRONMENTAL PROBLEMS IN THE LATIN AMERICAN CONTEXT

Urban environmental degradation is one of the main environmental challenges in Latin America (United Nations Environmental Program 2000). Atmospheric and water pollution, hazardous and solid waste disposal, floods and other environmental emergencies are just some of the problems affecting urban areas in the region. Latin American cities also face severe fiscal resource constraints and lax management systems, seriously damage the resources base of their surrounding hinterlands, and present health risks arising from vehicular and industrial air pollution, contaminated surface and ground water, and solid waste collection and disposal (Inter-American Development Bank 2007). The current urban environment in LA mega-cities is a result of complex processes of urban growth and development characterized by increases in urban population, unplanned urban growth, industrialization and weak governance (Gilbert 1996).[3]

Urban areas in Latin America and the Caribbean have had significant increases in urban population from 69.9 million in 1950 to 472 million in 2011. This trend of increasing urbanization is estimated to reach 650 million by the year 2050 (Population Division of the Department of Economic and Social Affairs of the United Nations

---

[3]Mega-cities are cities with at least 10 million inhabitants.

Secretariat 2012). By 2010 79% of the population in Latin America and the Caribbean lived in cities (Department of Economic and Social Affairs of the United Nations 2004) and 111 million people lived in slums (United Nations 2010).

Industrial wastes, air emissions, and legacy pollution from old industries affect the population of these cities. Early industrialization allowed industrial development on the basis of the existing technology and low or non-existing environmental standard. Industrial infrastructure became obsolete because there have not been considerable technological improvement of the industrial waste treatments and emissions. In addition, low levels of environmental law enforcement and the lack of systematic data on emissions do not guarantee that the level of industrial emissions and the scale of their impact are within acceptable levels (United Nations Environmental Program 2007). Moreover, urban growth also brought a considerable increase in the production of waste from industries and households sources. The increase in waste production made legal landfills and, to a larger extent, illegal landfills, another important source of urban pollution.

Even though urbanization processes in Latin America countries share several commonalities, there is a vast diversity of urban environments and environmental problems faced by urban settlements. These problems not only vary from city to city, but also within each city. This within city variation mark notable differences between the socio-economic characteristics of districts – rich and poor districts- (Barrow Christopher 2005). As a consequence of the rapid population increased of LA cities and the largely unplanned urban growth posses the most serious problems for the urban environment. In other words, it is the combination of "rapid urban growth coupled with poor governance" (Barrow Christopher 2005,130; Hardoy, Mitlin, and Satterthwaite 1992) which shaped these environmental outcomes.

In urban LA the poor spread into the periphery, with some smaller clusters of poverty concentrated in intermediate areas of the city that were not suitable for urbanization. Governments in LA have generally been permissive with land occupation, given their inability to cope with the demand and to provide adequate housing. These irregular settlements informally occupied public or private land. Land cost contributed to the environmental burdens imposed on the poor (Hardoy, Mitlin, and Satterthwaite 1992). High land prices constrain the access to adequate housing for the poor, thus informality represent an alternative to lower the cost of access to land (Ward 2009), and also limits their choices to marginal land (International Development Research Center 2005). In addition, the nature of the informal process of land production constrains their chances of mobility (Ward 2009) exposing the poor to long-run exposure to pollution.

The process of urbanization shaped the urban form by spatially separating of high income sectors from low income sectors. LA cities present spatial patterns of residential segregation.[4,5] Studies that measure residential segregation show the existence of

---

[4] Residential segregation has been defined by Massey and Denton (1988) as "the degree to which two or more groups live separately from one another, in different parts of the urban environment".

[5] Segregation at macro scale refers to the concentration in of different socio-economic groups in specific areas of the city while micro-segregation refers to a smaller geographic scale (Sabatini 2004)

segregation patterns in cities across the region, but to a lower degree than in US cities (Peters and Skolp 2009). Scholars show that Latin American cities present different segregation levels at macro and micro scale and between cities. For instance, in São Paulo (Brazil) residential segregation increased at the macro-level, while in the case of Buenos Aires it remained stable (Groisman and Suárez 2009).[6] Ward (1998) shows that in Mexico City the poor concentrate in specific areas of the city, but the social geography of the city is changing.

While traditionally the LA city structure was characterized by a concentration of elites around the city center and the poor occupied the periphery (Ward 2009 [referencing Johnston 1973]; Clarke 1983), changes in the production and consumption patterns of the urban space have made them more complex and fragmented. LA cities became characterized by a multiple 'islands' with specific types of land uses or functions; namely, production, new type of residential products (for high and middle classes), business and low income housing (Janoschka 2002). In this way gentrification processes and in-fill of vacant land started to reverse the spatial polarization between social areas at the macro-level; however, segregation between settlements of different classes are sharpening at the micro-level (Ward 2009). Santiago (Chile) also shows a reduction in the segregation patterns at the macro-scale and an increase at the micro scale (Sabatini, 2001). Regardless of these differences and city-country specific contexts, at the macro scale Latin American cities still present residential segregation patterns characterized by

[6] It is important to consider that the scale definition affects the results given the Modifiable Aerial Unit Problem discussed in the quantitative part of this study.

concentration of high-income or low income neighborhoods in specific parts of the cities. Studies show that the poor living in segregated areas have many disadvantages, such as unequal access and quality of public services, lower educational performance, employment opportunities, among others differences (Flores 2008; Flores and Wilson 2009; Pinto da Cunha and Jiménez 2009; Torres and Bichir 2009).

The Urban Environment of the AMBA

Buenos Aires is one of the Latin American 'mega-cities' along with Mexico City, São Pablo and Rio de Janeiro. These mega-cities concentrate a large part of the population and economic wealth of their countries, but they also "demonstrate many of the worst symptoms of the region's underdevelopment: vast areas of shanty towns, huge numbers of poor people, high concentration of air and water pollution, and serious levels of traffic congestion" (Gilbert 1997, 1). In this context, several reasons justify the focus of this project on the urban environmental pollution in the AMBA. Its size and its high levels of concentration of economic activities and polluting sources make the metropolitan area of Buenos Aires an especially relevant case of study.

The AMBA concentrates a population of 12 million inhabitants, which represents around one third of the total Argentinean population (INDEC, 2001). In spatial terms, the population's patterns are characterized by the concentration of high-income neighborhoods in two specific locations: the city center and the north corridor; the socio-economic status of the population decreases from these areas to the periphery (Argentinean Household Survey, 2006). Groisman and Suárez (2009) show a similar pattern of residential segregation for the city, in which there is a concentration of high-income segregated areas in the center-north, and segregated areas of low-income population in the periphery and in the south. Similarly, this spatial distribution is reflected in the availability, quality, and access to public services.

The environmental dimension of industrial production is closely linked with the industrialization process of the city. As the capital city of an early urbanized country, Buenos Aires concentrated import-substitution industries (ISI) since the early 1930s. However,, by the end of the ISI model in the 1970s, the opening of markets and industrial decentralization generated a process of de-industrialization of the AMBA (Pírez 1994). In the first decade of the XXI century the AMBA produces 46% of the national Gross Geographic Product, and concentrates 44 percent of the national manufacturing sector (data for year 2006; Subsecretaría de Urbanismo y Vivienda, 2008). Despite the general trend of decreasing industrial activity in the country during the 1990s, the AMBA still holds an important share of the industrial production in the country.[7]

The early industrialization and the de-industrialization periods have significant implications for the quality of the urban environment because industries have not been modernized, they lack adequate waste treatment processes, and have low environmental standards. Furthermore the process of de-industrialization also left abandoned many

[7] According to Borello and Vio (2000) industrial employment decreased approximately 20% in the metropolitan region from 1985 to 1994.

polluted industrial sites. These sites contained contaminants left behind from previous activities that were inappropriately treated even when the sites were redeveloped. This has created a number of serious environmental problems in the Buenos Aires Metropolitan Area, such as the Matanza-Riachuelo River Basin which is considered "Argentina's worst environmental hotspot with more than 3,500 polluting tanneries, oil, chemical, and metal plants, illicit sewage pipes and 42 open garbage dumps along the river" (Blacksmith Institute 2007, 31).[8]

In addition to its socio-economic characteristics and industrial features, the AMBA presents an extremely complex and fragmented structure of governance. The territory of the AMBA encompassed the jurisdictions of the governments of the City of Buenos Aires (central city), the Province of Buenos Aires, 24 municipalities, and the Federal government (Pirez 2006). As in many metropolitan areas in the region, this complex structure of governance raises additional challenges and present constrains for dealing with urban environmental issues. As Bartone argues "while urban governance issues deal with political boundaries, environmental impacts respect only natural boundaries such as watersheds, underlying aquifers, coastal zones, or urban air sheds" (2001, 3) The combination of all these characteristics contributes to the complex geography of the urban environment, and it is reflected in serious environmental problems related to different stationary sources of pollution such as industries, illegal and legal landfills and incinerators. The high concentration of population and segregation

[8] According to the Blacksmith Institution (2007), the Riachuelo-Matanza River Basin is among the thirty dirtiest places in the world.

patterns, as well as diverse economic production, complex government structure, important variation in the type of polluting sources and in the territorial distribution of environmental pollution is what makes the Metropolitan Area of Buenos Aires an especially relevant case for the study of the phenomenon of urban environmental pollution and public policy in Latin America. The historical evolution of the AMBA will be discussed in more depth in Chapter 3.

Literature Approaches in Latin America

As Auyero and Swistun (2007) point out, issues of urban environment and poverty have rarely been the object of academic research in Latin America.[9] Studies that do address this topic tend to focus on specific cases without considering the broader conditions that shape the life of the poor (see for example Hardoy 1997, Satterthwaite, 2003). Some ethnographic studies linking urban environment and poverty focus on risk perception and address the question of how environmental risk is perceived and how and why a community shares in the "social production of toxic uncertainty" (Auyero and Swistun 2007; Auyero and Swistun 2008).

Meanwhile most of the literature on urban poverty in Latin America focuses on housing conditions and access to public services, and usually only upon the spatial

[9] Beyond the urban studies arena, some studies in LA have begun to address environmental inequalities. They mainly focus on the inequitable access to land and natural resources, environment- social movements and global economy.

boundaries of poor neighborhoods. These studies rarely refer the neighborhoods effects and negative externalities faced by low-income neighborhoods as a consequence of their location in the broader urban landscape. Furthermore, these studies examine issues of urban poverty focusing on certain stand-alone issues of housing policy, land regularization, infrastructure provision and upgrading, but they do not consider poverty in relation to broader urban issues such as land uses, pollution, actors and local governments' strategies regarding the urban environment.

Studies that do analyze the spatial patterns of population distribution -residential segregation- have mainly focused on the effects that segregation has upon educational outcomes, and upon the quality and access to services, contributing to the debate of specific sectoral policies, however, they rarely address the relationship between patterns of segregation and environmental conditions, and how the environment contributes to segregation patterns.

RESEARCH OBJECTIVES AND CONTRIBUTIONS

The objective of this dissertation is to study the driving factors of population exposure to sources of environmental pollution. It also analyzes whether the concentration of polluting industries within neighborhoods of different socio-economic levels varies over time and if distribution of environmental pollution represents another manifestation of urban inequality in LA cities. In short, it explores whether poor neighborhoods are disproportionately exposed to negative environmental externalities.

This study analyzes first the relationship between the spatial distribution of population and industrial sources of urban environmental pollution in 12 partidos of the AMBA. It attempts to determine the factors that shape the distribution of hazardous facilities and the existence of environmental inequalities. This research objective focuses on the following questions: What factors account for the current spatial distribution of sources of industrial pollution? Do specific characteristics of the territory influence the spatial concentration of polluting industries? Are the poor disproportionately exposed to industrial pollution? Do segregated areas face disproportionately exposure to negative environmental externalities? Do these relationships vary over the space? These questions provide an important insight to the current outcomes at a macro-scale.

The second research objective is to explore the causes that determine the current outcomes. This research argues that environmental outcomes are the result of a complex temporal process in which different factors and actors' strategies and interests are combined. These combinations will determine whether neighborhoods' increased or decreased the concentration level of polluting facilities. Furthermore, this project explores the different weights of causal factors in establishing neighborhoods trajectories over time. This is achieved by looking at the processes and mechanisms that shape the relationship between residents and polluting industries in two neighborhoods of the AMBA with different socio-economic status. To do so the study analyzes the socio-economic, institutional and market factors operating in the AMBA. This historical approach allows me to study and understand the development of the causal processes behind the observed outcomes.

The second research objective addresses causality through the following questions: how socio-economic, institutional and market factors shaped the relationship between polluting industrial concentration and different socio-economic sectors? Do different socio-economic neighborhoods follow the same trajectories over time? If differences exist, what are the causes of these different trajectories? What strategies are employed by different actors (firms, residents and local governments) to affect the industrial trajectories of the neighborhoods and the environmental outcomes? In addressing these objectives, this study takes an interdisciplinary approach that integrates theoretical frameworks from epidemiology, economic geography, political science, sociology, urban planning and management, as well as from the public policy literature.

This research makes an important contribution to the understanding of the relationship between industrial pollution and population, and more specifically, to the understanding of environmental inequalities in a Latin American city. Salient issues as inequity and urban environmental pollution have received little attention by Latin American scholars. This study attempts to understand the spatial outcomes of urban environmental pollution, and the processes shaping them in the Metropolitan Area of

Buenos Aires. This focus on the Latin American context is important because environmental spatial outcomes respond to the specific context in which they occurred.[10]

In this regard this study incorporates the history of places by considering the evolution of the AMBA. The historical process encompasses socio-economic, institutional and market processes that shaped the relationship between sources of pollution and urban population at the metropolitan as well as at the neighborhood scale. Specifically, this historical analysis explores the causes of continuity and change in this relationship. This study contributes to identify the extent by which neighborhoods' trajectories are constrained by broader external factors, and at the same time, it contributes to the understanding of how local actors shape local trajectories. In this respect, this dissertation intends to improve our understanding of the linking mechanism between urban poverty and pollution in Latin America.

In relation to the methodological contributions, this study is based upon a mixed-methods analytical framework. The mixed-method approach intends to overcome the limits of partial explanations provided by each methodology and offer a better understanding of the complex character of social phenomena (Greene 2008). In this research quantitative and qualitative approaches address different aspects of the research problem (Woolley 2009) at different scales of analysis (i.e. metropolitan and neighborhood scales). Together, these approaches identify patterns of 'regularity' at the metropolitan scale as well as 'particularity' (variation and differences) between cases

[10] In the US context, for instance research on urban environmental inequality has stressed how this is linked to racial issues and racial discriminatory practices. However, in the case of Latin American cities, racial factors might not play the same role to understand the phenomena of urban environmental inequality.

(Greene 2008). The quantitative approach incorporates local statistical and GIS techniques to assess the exposure of low income populations to pollutants. Additionally, the qualitative analyses focuses on a comparative case studies analysis that address the complex processes that lead to unequal patterns of exposure to pollution. The contribution of the case studies lies in the comparative approach of different socio-economic groups. Generally, studies that concentrate on the relationship between sources of pollution and population tend to focus only on poor neighborhoods, looking only at the processes in these settlements. This lack of comparison between processes of exposure of different socio-economic groups does not allow us to weight variation among the explanatory factors in different cases. This study contributes in this regard by analyzing dissimilarities and commonalities between cases. Thus the differentiation between areas of the city and neighborhoods can help us to disentangle the role that market and institutional factors play in shaping the relationship between low socio-economic sectors of the city and the urban environment. This complementary approach is relatively uncommon in the existing literature.

Finally, this research contributes to the policy debate in Latin America on the role of local governments and actors in mediating the relationship between sources of industrial pollution and population exposed to them. Specifically several policy implications arise in terms of the role of planning, public participation, access to information and transparency in the decision making process and law enforcement. This discussion is developed in the concluding chapter of this dissertation.

DISSERTATION OVERVIEW

The dissertation is organized into six chapters that develop constituent parts of this dissertation. **Chapter 2** presents the theory and the research design of this study. The chapter starts by developing the theoretical framework of this research that incorporates a multidisciplinary approach from urban-economy, political sciences, geography, urban planning and the environmental justice literature to help explain the relationship between polluting industries and population. Then it presents the research design and the mixed-methods approach which offers an overview of the space-based and spatial-temporal methods of analysis used in this study. These complementary approaches that include quantitative and qualitative methods address the spatial distribution of polluting facilities and population and the temporal processes that mediate the current relationship of such distributions.

Chapter 3 offers an overview of the historical process of urban growth and industrialization of the Metropolitan Area of Buenos Aires framed in the theoretical explanations presented in the previous chapter. It provides the foundation for analyzing the historical process of the AMBA and the metropolitan context of the current spatial outcomes. It presents the industrialization and urban growth process of the AMBA, and the spatial outcomes that the economic models have left into the city. The chapter also analyzes planning and policies that have shaped the urban structure.

Chapter 4 outlines the quantitative methodology employed for analyzing the relationship between industrial sources of pollution and population in 12 partidos of the

AMBA. It combines analytic and exploratory techniques based on relevant theories developed by the literature, and is informed by a detailed data analysis at the census tract level. The first component of the quantitative analysis uses global models to describe variable-based linear analysis to examine the relationship between industrial density and social and spatial factors. The second component is more exploratory in nature and addresses the spatial variation of this relationship over the metropolitan space. This chapter provides a general overview of the Geographically Weighted Regression (GWR) model that is used in this study; this is an exploratory approach that specifically considers the local characteristics and spatial variation of this relationship across the metropolitan space. It concludes with the main results.

Chapter 5's main objective is to understand how socio-economic, institutional and market factors shape the distribution of environmental outcomes and mediate the relationship between sources of environmental pollution and residents living in nearby areas. It will address the issue of causality and policy outcomes. The analysis seeks to understand and explain the continuity and change of these outcomes over time in two different socio-economic neighborhoods.

Finally, **Chapter 6** summarizes the rationale of this study and discusses its main findings. It also discusses the policy implications and the future research agenda generated by this dissertation.

CHAPTER 2

THEORY AND RESEARCH DESIGN

To explain the relationship between sources of environmental pollution and population, three main theories have been developed: socio-economic, institutional, and market theories. Each theoretical framework identifies important variables that mediate this relationship. However, when treated individually, these explanations are limited in their capacity to address the complexity of this relationship. In this regard, this study argues that such explanations are complementary and that the weight of each explanation is relative depending on the contextual or external factors that operate within the historical process of the places. Moreover, this context will shape the different actors strategies and will determine the continuity or changes in the relationship between sources of pollution and residents. The combination of these theoretical frameworks within the specific context in which they occurred provides for a better understanding of the causes and processes of population's exposure to negative externalities.

The objective of this chapter is to frame the theoretical and methodological foundations of this research. The first part of the chapter presents the theoretical framework—discussing the socio-economic, institutional and market theories. The second half develops the methodological approach adopted and discusses the research design based on a mixed-methods approach. Specifically, it describes a quantitative analysis, introducing the space-based analysis, as well as a qualitative approach that seeks to explain how the spatial-temporal analysis is implemented through comparative case studies.

LITERATURE REVIEW

The relationship between sources of pollution and population has been analyzed in terms of the unequal level of exposure of the poor to environmental externalities. These environmental inequalities imply an unequal distribution of environmental cost across society. Studies from several disciplines acknowledge that the urban poor are disproportionately exposed to environmental degradation (Hardoy and Satterthwaite 1997; Satterthwaite 2003). Specifically, the environmental justice literature explores the relationship between sources of pollution and socio-demographic and racial characteristics of the population.[11] Scholars explore whether inequalities exist and the mechanisms behind them; however, they differ on the degree of inequalities and possible causes.[12] Despite the numerous studies, research has not progressed much beyond

[11] The environmental justice movement emerged in the United States as a part of the civil rights movement. Following Rawls' (1971) theory of distributive justice, environmental justice refers to the disproportionate impacts of environmental hazards on racial and minority groups.

[12] See, for example, United Church of Christ (1987); Bullard (1990); Bowen et al. (1995); Krieg (1995); Hardoy and Satterthwaite (1997); Boone and Modarres (1999); Cutter et al. (2000); Pulido (2000); Szasz and Meuser (2000); Baden and Coursey (2002); Bolin et al. (2002); Lejano et al. (2002); Pastor et al. (2004).

demonstrating that the relationship exists (Saha 2002), and the present study proposes to develop the exploration of the causes of environmental inequalities.

To analyze this phenomenon, scholars and institutions apply three main theoretical approaches to explain the unequal distribution of sources of pollution in urban environments: i) socio-economic factors, ii) institutional factors, and iii) market factors. These approaches aim to account for urban dynamics and socio-spatial processes that shape the spatial outcomes of environmental pollution and have often been treated as competing explanations, although they may be complementary (Saha and Mohai 2005). These explanations are generally interconnected and sometimes overlap given the complexity and inter-relatedness of socio-economic, institutional and market factors.

Socio-Economic Explanations

Socio-economic centered explanations stress the characteristics of the population that is exposed to environmental pollution and risks. The main hypothesis is that minorities and the poor are disproportionately exposed to sources of contaminant emissions. The principal argument behind this hypothesis is that socio-economic characteristics strongly influence the siting decisions for hazardous facilities and, therefore, the likelihood for certain social groups to experience environmental vulnerability. Consequently, the unequal patterns of pollution result from broader socio-spatial processes (Pulido 2000) that take place in the metropolitan or regional space. In this context, the poor are conceived as “attractors” of pollution, while middle- and high-income population groups are better able to resist and to distance themselves from pollution (Pulido 2000). This argument of environmental inequality frames the unequal distribution of polluting sources in terms of the community’s economic needs and its capacity to reject polluting activities. Bullard (1992) attributes the inequalities generated by the local acceptance of polluting facilities to the residents’ desire to improve local economic opportunities and to engage in what is sometimes described as “environmental blackmail”—when residents out of need for local sources of employment are forced to accept polluting sites and, hence, be exposed to pollution. Both factors make it more likely for polluting activities to locate in poor neighborhoods.

From the community needs’ perspective, disadvantaged communities are more willing to host any type of economic activity regardless of its environmental implications to attract local employment and increase local revenue (Schweitzer and Stephenson 2007). From the community capacity perspective, the unequal distribution of local undesirable land uses—or LULUs, as they are commonly known—in poor neighborhoods is framed in terms of political influence and participation. Having less political influence compared to more affluent communities, these neighborhoods have higher likelihood of playing host to polluting activities and less capacity to oppose them (Mohai, Pellow, and Roberts 2009). The poor’s lesser political influence has been attributed to several factors, such as lack of resources and ability to mobilize, as well as the inability to influence elected officials (Mohai, Pellow, and Roberts 2009). In addition, the poor's political underrepresentation limits their involvement in the decision-making process (Lineberry 1977). Low-income communities may have less economic, political, organizational and technical resources; they are also less likely to be aware of specific developmental projects and proposals, and the risks associated with them. Consequently, groups with less resources, less political clout, and lower active participation tend to be less effective in collective action campaigns to oppose pollution and are more likely to face higher negative environmental externalities (Bullard 1990; Nabalamba 2001).

Middle- and upper-class neighborhoods, on the contrary, are characterized by their ability to escape pollution, similar to the white-flight suburbanization phenomenon in the United States. According to Pulido (2000), the socio-economic advantages of middle and upper classes are another form of discrimination that accounts for disparate urban environmental patterns. This view argues that some sectors of society accrue privileges and benefits which distance such groups from noxious urban environments, shaping the spatial outcomes of environmental pollution. These privileges play an important role in partially isolating those sectors of society from comparable amounts of pollution to the poor. These privileges also include economic and political benefits, such as organizational capacity, power relationships, and influential social networks.

The advantage of certain groups over others clearly raises issues of equity. According to Pulido (2000, 16), "it is impossible to privilege one group without disadvantaging the other." In this context, the issue of equity refers to who faces the costs of pollution. Under the socio-economic approach, spatial outcomes of urban environmental pollution depend on large socio-spatial processes that include both sides of the economic spectrum which, in turn, define the spatial distribution of environmental costs. On one hand, the approach associates high-income sectors of society to their ability to avoid facing negative environmental externalities; while on the other hand, it connects the specific needs and capacities of poor neighborhoods to their likelihood of being more vulnerable to such externalities. These socio-spatial processes strongly influence the final distribution of environmental externalities, drawing an uneven pattern of polluting sites to areas with high concentrations of poor households.

Institutional-Centered Explanations

The institution-centered explanations emphasize that government and public policies account for the spatial outcomes of urban environmental pollution. These explanations stress multiple institutional factors as affecting the outcomes; these factors include: institutional economic developmental policies, the nature of land-use assignation and zoning, bureaucratic practices, the inertia of past decisions in the current decision-making process, and institutional environment.

The characteristics of places are not simply the result of the market portioning out land uses according to supply and demand, they are also the result of choices (whether made deliberately or unknowingly) by government officials as well as by business owners and land developers (Lejano and Smith 2006). From an urban economy perspective, industrial development constitutes a source of local economic gain and employment opportunities. In this sense, negative environmental externalities, such as pollution and environmental risk, can be mainly considered as side effects of development policies that are directly associated with incentives to promote industrialization in some parts of the urban space and not in others. For example, in the case of communities experiencing economic decline, these local undesirable land uses (LULUs) may represent an opportunity for local employment (Bohon and Humphrey 2000). In this context, when opportunities for development are perceived as scarce, some communities may be willing to accept LULUs like polluting industries or hazardous waste facilities (Bohon and Humphrey 2000, 377 [referencing Bourke 1994]).

The spatial allocations of such activities are implemented through local planning and land use regulations that shape the location of sources of environmental pollution and represent critical factors for explaining their spatial distribution (Boone and Modarres 1999). Land markets are defined by public institutions or agencies that establish formal rules like property rights, taxes on properties, zoning restrictions imposed by planning, and other laws. These sets of formal rules are explicitly introduced by institutions to achieve a desirable outcome (Needham and Louw 2006). As in service delivery, the distribution of LULUs are a product of the urban policy-making process, and this takes place within a structure composed broadly of urban elites, politicians, interest groups, and municipal bureaucracies (Lineberry 1977). In this way, the decision of the spatial allocation of LULUs is a result of the pushing and hauling of local interest groups and elected decision-makers.

As part of the urban decision-making process the bureaucracy plays an important role in how land uses are allocated in the space. According to Lineberry (1977, 17), "bureaucracies develop decision-rules in considerable autonomy from external elements and apply rules to routinize the allocation decisions they make." From this perspective, the spatial allocation of LULUs is often defined by technocratic criteria alone, or in combination with political decisions. This decision-making process tends to be compartmentalized, subject to bureaucratic routinization, and deeply embedded in a technocratic mindset (Lejano, Piazza, and Houston 2002). For this reason once LULU areas are defined in zoning ordinances, the bureaucratic inertia may drive towards a negative institutional lock-in where subsequent land-use changes are difficult to implement.

There is also a temporal dimension on the spatial distribution of LULUs. These land uses are a result of the historical development of places that involves development policies and industrial processes that took place a long time ago. These processes not only crystallize the resulting urban form but also frame its future path. The history of places has an important role in shaping the fate of these areas and how institutions see their future development opportunities. In that respect, there is path dependency in deciding the location of production in space and this reinforces the continuity of existing spatial patterns (Krugman 1991). Following the rationale of path-dependence there are three explanations that can explain the spatial distribution of local distribution of undesirable land uses (LULUs) and environmental externalities. i) the utilitarian approach assumes that practices are rationally reproduced because any potential benefit of transformation is outweighed by the costs (Mahoney 2000); such that these mechanisms of reproduction can cause the prevalence of inefficient outcomes (Woodlief 1998). Under the utilitarian perspective, land uses policies will tend to duplicate the existing land use patterns to increase returns. ii) The "power approach" explains the self-reinforcement mechanisms based in the cost benefit analysis where the distribution of costs and benefits are uneven. Even though individuals or groups prefer to change policies or practices, they persist because existing policies provide benefits to the elites, and it is in the interest of such groups that the self-reinforcing mechanisms continue to operate. In this case, the distribution of LULUs is determined by elites' interests. Under this perspective, changes can be introduced when elites' and firms' interests switch to more profitable land uses. iii) Policy reproduction can be analyzed in terms of legitimacy; and under this perspective the actor's self-understanding and beliefs about what is appropriate or morally correct lead to adopt self-reinforcing mechanisms. Changes in the self-reproduction mechanisms occur when it is no longer in the actor's interest to reproduce them (Mahoney 2000). They can be changed or replaced when forceful alternative or new ideas that are incompatible are introduced. Finally, the legitimacy approach stresses the legitimate idea of development and employment opportunities, a change in this paradigm could be introduced in those cases in which the ideas of environmental and equity issues have gained acceptance (Mahoney 2004).

The assignation of urban land uses has a distributional impact in terms of environmental costs and benefits. However, in the allocation of LULUs, decision makers do not fully consider the impacts of these activities on the environment and on the quality of life in the surrounding areas (Lejano, Piazza, and Houston 2002). Moreover, it is not clear how, and to what extent, the distributional effects are taken into account in the decision making process. If urban planning and zoning ordinances are tools for the spatial allocation of LULUs, their location may create spatial inequalities. The location of industrial facilities and sites favors or disfavors those living nearby and, thus, redistributes well-being or ill-being in the territory (Smith 1974).

Finally, the institutional climate also sets the conditions to attract investments in new facilities. Local politics and business climate influence siting decisions of new facilities in terms of the estimate of potential costs and conflicts associated with their activities (Boone and Modarres 1999). In this sense, it has been argued that new polluting activities tend to be located in areas with more lenient zoning, more permissive site requirements, and lesser law enforcement (Lejano and Smith 2006). That is, they tend to be located in weaker or more flexible jurisdictions with regard to environmental effects.

From the institutional perspective, institutions set the rules of the game regarding spatial allocation of land uses in general and mediate between interest groups. But it is also the decision-making process which determines the LULU’s stability and accumulation over time. The institutional approach, therefore, stresses the central role that the policy decision-making process and policy tools have in defining the spatial outcomes of urban environmental pollution and the distribution of environmental externalities.

Market-Centered Explanations

Market-centered explanations stress the role of market forces in shaping the location of industries, hazardous waste facilities, and population in the urban space. Based on a rational choice model, industry site-selection and household residential-location decisions follow market rationality (Saha and Mohai 2005). In other words, all action is fundamentally rational in character, and individuals as well as firms calculate the likely costs and benefits of any action before deciding what to do. From a neo-classical approach, polluting firms select their location based on the economic logic of cost minimization and profit maximization. Under this perspective, firms make their location decisions by considering territorial characteristics that affect their profits (Arauzo Carod 2004). In selecting a location, firms consider a variety of factors and costs, including labor supply, access to market and to political power, taxes, transportation costs, facilities, power supply, access to resources and services -e.g., raw materials, water and sewage, and land- (Blair and Permus 1987; Szasz and Meuser 1997), industrial clusters and agglomeration economies as well as their externalities (Hamilton

1993), and possible opposition costs. However, the weight of each of these factors varies according to the type of production and industrial size (Sweeney and Feser 2004).

Traditionally, transportation costs influence location decisions based on cost minimization, and from this perspective, the best location is that of the combination of least cost of transporting raw materials to the plant and getting product to the market (Blair and Permus 1987). Besides these costs there is a trade-off between location factors, such as low wages, energy costs, minimal opposition, among others, which are also considered by the firms at the time of siting (Blair and Permus 1987), and the advantages derived from agglomeration economies and industrial clusters.

In this sense, the presence of industrial clusters constitutes an important factor for the location of firms in the space. Spatial proximity stimulates the process of collective learning that lowers transaction costs and encourages coordination between actors (Boschman and Lambooy 1999). The spatial concentration of firms in the territory offers a pooled market for workers with industry-specific skills which ensures lower likelihood of labor shortage, supports the production of non-tradable specialized inputs, and promotes knowledge spillovers that allow firms to have higher productivity levels than isolated producers (Krugman 1991). Traditional industrial areas offer comparative advantages for the location of new firms given the accumulation of human capital and existing network externalities, as well as the presence of supportive institutions (Boschman and Lambooy 1999).

Land values play an important role in locational decisions of firms and people. From the firm's perspective, among transaction costs land values are particularly important at the urban and metropolitan scales because land is a micro-geographic (or intraregional) factor, so once a firm selects a city or a region, land values are likely to affect a firm's location choices depending on whether it is market sensitive or not. While in market-sensitive firms proximity to sources of demand represents a constraint to their location choices (Blair 1987 [referencing Schemenner 73]), "industries that do not depend or benefit from access to amenities, consumers, and services associated with higher income urban areas will gravitate to areas where property values are not driven by these factors" (Lejano, Piazza, and Houston 2002, 874).

Social opposition costs also play an important role in a firm's siting decision. Besides the traditional siting costs faced by any firm, polluting industries face additional costs related to the nature of their production and to the possible environmental impacts they pose to the areas in which they are located. In this sense the literature on environmental justice argues that public opposition is an additional cost for siting facilities (Hamilton 1993); therefore, in order to avoid these costs facilities tend to follow the path of least social resistance (Mohai, Pellow, and Roberts 2009). Consequently, differences in social mobilization and political power among communities represent a major structural reason for the location of unwanted facilities (Schweitzer and Stephenson 2007).

According to Hamilton (1993), a firm that generates negative environmental externalities takes into account the ”amount of expressed opposition” in the community before siting or expanding their facilities because such opposition may raise the transaction costs of litigation and regulatory hearings, increase the compensation paid to the community for environmental damages, and increase the facilities’ operating costs once operations start. To reduce future liabilities for pollution, firms consider the physical and demographic characteristics of the area—such as density, income, vulnerability of property values, and residents’ willingness to pay for environmental amenities—that would influence the cost of externalities.

Neighborhoods facing potential pollution may differ in effective opposition because of different levels of political participation. The higher the potential for public opposition, the higher a firm’s expected costs of litigation, lobbying, and compensation, and thus, the less likely a firm will locate in any of those neighborhoods (Hamilton 1993). The opposition expressed by a community is, according to Hamilton (1993), directly linked to the value placed on the environmental degradation posed by the facility, This value, in turn, determines the amount of compensation to be demanded and the community’s willingness to spend resources to mount an opposition and engage in the collective action necessary to oppose the siting or facility’s expansion through a political process. If public opposition demands that the firms internalize their externalities in their location decisions, then differences in public participation could explain why poor neighborhoods would be less costly locations for polluting firms (Hamilton 1995).

Public opposition is not only reflected in compensation costs incurred by hazardous firms but also in costs associated with winning the acceptance of the community in which these firms are or plan to be located, such as costs of participating in regulatory processes and court litigations, opportunity costs imposed by delay in facility construction or fitting, future liabilities, costs of preventive closure, and direct payments to the community through corporate donations or taxes (Hamilton 1993). Even though the logic of industrial location does not take directly into account the distributional consequences of location (Portney 1994), firms do consider the potential costs associated with their operations.

Besides the theoretical arguments of cost-minimization, profit maximization, and agglomeration economies, firm location theory also recognizes that not all location decisions follow strictly the neo-classical logic. Evolutionary economics and behavioral geography argue that firms' locational choices are not necessarily rational because they depend on firm-specific competences and on the availability of information (Boschman and Lambooy 1999). Moreover, the location of a new firm may also be random, based upon the personal preferences of the entrepreneur. According to Blair and Premus (1987), new businesses are less sensitive to profit maximization, and in some cases, personal preferences may play a relatively greater role in locational decisions. New firms, for example, may be located close to where the owners reside or have resided because of favorable experiences with the area.

Siting and post-siting effects upon the housing market

The complex interaction of economic factors produce localized consequences that influence the land and housing market. According to Can (1992), there are two types of locational effects: neighborhood and adjacency effects. On one hand, neighborhood effects are associated with socio-economic and physical characteristics of the neighborhood, and access to urban amenities. On the other hand, the adjacency effects refer to positive or negative effects caused by externalities. Both types of locational effects shape the spatial distribution of people and industries in the territory; however, which one prime over the other is difficult to discern.

Changes in the host neighborhood occur as a consequence of the siting of new facilities or post-siting of noxious facilities in a neighborhood.[13] The siting process describes the factors that attract firms into a giving area. In this regard scholars argue that in order to minimize transaction costs firms target low socio-economic population and areas with low land values. The post-siting process refers to changes in the host neighborhoods (i.e. environmental quality, land values or social composition of the area) that occur as a consequence of the presence of polluting facilities. The post-siting effects can cause social reaction depending on the real or perceived deterioration of the urban environment and the residents' value placed on the environmental quality. Both siting

[13] The negative effects of polluting activities are related to a large size individual industry, as well as to the concentration of several polluting industries. Industrial clusters have an important cumulative effect in the host neighborhood and nearby areas depending upon the number of industries, type of production and their environmental effects.

and post-siting would cause a disproportionate presence of polluting facilities in low-income neighborhoods.

Low land values can be a characteristic of the land before the polluting activities locate there or can be a direct consequence of the concentration of LULUs. This has twofold implications. i) Low land values in poor neighborhoods can be a reason to attract firms (siting), while firms are more prone to locate in low-income communities because they provide the most efficient location in terms of land prices (Been 1994) and compensation costs Portney (1991a). It is for these reasons that industrial zones often coincide with low-income neighborhoods (Saha and Mohai 2005, 619 [referencing Portney 1991a]). Therefore, low-income-neighborhood land markets dynamics attract LULUs. ii) The concentration of polluting firms can be a factor that drives down land values, attracting more industries and the poor (post-siting). The post-siting effect occurs as a response to the presence of noxious facilities and other LULUs as relatively high-income residents moved to areas with better environmental conditions (Pulido 2000). As a consequence of the negative externalities the quality of life decline and drives down the property values. The departure of these groups has a direct impact on the land and housing market. In a downward spiral, more affluent groups would tend to move to better quality areas, while decreases in housing values make the host neighborhood more affordable to low income population (Been 1994; Hamilton 1995). Thus, these neighborhoods provide ample affordable housing for disproportionately low-income groups and minorities, thereby creating new disparities or worsening ones that already exist at the time of siting (Been and Gupta 1997). In this way, environmental disparities can be explained as a result of the land and housing market dynamics, such that the placement of polluting activities in some areas of the city attracts low income population to these neighborhoods due to the falling housing prices (Lambert and Boerner 1997). Scholars argue that environmental inequalities are the product of demographic changes after siting (Been 1994; Bullard 1983; Mohai, Pellow, and Roberts 2009) because the presence of these facilities deepen the disparities between host-neighborhoods and non-host neighborhoods (Saha 2002).

Looking at the micro-geographical scale, the areas in which there is a coincidence of high concentration of polluting industries and poverty tend to suffer from depressed economic conditions in comparison to other areas in the city or region (Saha 2002). In a self-reinforcing process these areas become more accessible for low income population and attractive for industrial development. These processes can lead to an economic downgrading and decline of the host neighborhoods, though this lineal process does not necessarily occur. However, areas with high concentration of polluting industries do not necessarily undergo to an economic decline; on the contrary, an industrial presence can improve the economic conditions of the neighborhood.[14] Moreover, the economic fate of these neighborhoods could not be only explained based merely in neighborhood's inherent qualities. Economic decline can also occur as a consequence of the geographic location and broader economic forces. In this sense, neighborhoods' relative location and

[14] In some cases the industrial development brings services and employment opportunities. Whether or not they have a positive economic effect overall will depend on the situation of the neighborhood before siting, as well as the type of production.

their functional relationship with the rest of the urban structure can shape their destiny. Not only does a firm's siting or post–siting effect explain the presence of the poor, the complex functionality of the urban structure can also shape the spatial location of low-income neighborhoods.

In Latin America the land and housing market dynamics have specific characteristics that shape the spatial distribution of the poor in urban areas. In the developing world formal and informal land markets coexist. The development of the informal market is driven by the high prices of serviced land, the high standards that legislation imposes on formal land development, such that the informal market is the only available and affordable option for the poor. Given the high prices of urban land, the poor develop different strategies to have access to low cost housing such as land invasion and the development of illegal housing areas and self-help housing. In the region, there is an important proportion of illegal land market transactions with different characteristics; the illegal character of urban land rests in the illegal occupation of public or private land, uncertainty about the property legal rights or because the self-help housing construction process do not meet the regulatory standards (Gilbert and Ward 1988). The land in which the squatter settle usually has poor or no environmental services or is located in marginal sites close to landfills or polluting industries and suffers from environmental degradation (International Development Research Center 2005). For these reasons, land tenure is considered closely related to the exposure of the poor to sources of pollution. Location and housing characteristics aggravate the general living conditions of the poor and make them more vulnerable to suffer the effects of environmental externalities.

Market factors play a significant role in modeling the spatial outcomes of the urban environment. Firms' siting decisions generally follow a market rationality influenced by a variety of factors associated with costs minimization, socio-economic characteristics of the population and opposition costs, as well as institutional climate. How each aspect influences firms' location will depend on the type of the activity, the industrial size and the cost and benefits of internalizing externality costs that they create. On the other hand, housing market dynamics also limit the locational choices of the poor, in excluding them from the formal market and forcing them to trade-off exposure to environmental risk for affordable housing.

RESEARCH DESIGN: INTEGRATING TWO CULTURES IN POLICY RESEARCH

This study proposes in its research design to integrate quantitative and qualitative methods. According to Mahoney and Goertz (2006), quantitative and qualitative techniques can be thought of as different cultures. While statistical research estimates the average effects of one or more variables across a population of cases, the goal of qualitative analysis is to explain individual cases and to identify the causes of a specific outcome (Mahoney and Goertz 2006). A key contribution of qualitative research is that it focuses on how the combination and interaction of variables lead to a given outcome—

that is, that the context and conditions under which certain factors operate influence their possible effects.[15] A mixed-methods analytical framework, in turn, allows researchers to overcome the limits of partial explanations provided by each methodological approach, offering a better understanding of the complex character of social phenomena (Greene 2008).

In this research the complementary use of quantitative and qualitative approaches addresses different aspects of the research problem (Woolley 2009) at different scales of analysis. This approach integrates a quantitative space-based method and a qualitative spaced-temporal analysis. The former addresses the current spatial distribution of polluting industries at the metropolitan scale. The latter analyzes specifically the causal paths that mediate the current relationship between industrial density and population. Together, these approaches identify patterns of 'regularity' at the metropolitan scale as well as 'particularity' (variation and differences) between cases (Greene 2008).

The analysis of spatial outcomes of environmental pollution has focused increasingly over time on geographical patterns and historical processes in urban areas (Holifield 2001). Generally, the literature addresses this issue from either a quantitative or a qualitative approach, but rarely does a study employ both. Using statistical and GIS techniques, quantitative studies test the disproportionate exposure of low income population and minorities to pollutants (Baden and Coursey 2002; Fricker 2001; Kreig 1995). However, quantitative studies present methodological limitations that include: i)

[15] According to Mahoney (2006) qualitative research often focus in a combination of variables and occasionally on the effects of individual variables. The effect of a given variable can have sometimes positive or negative effects because it effects depend on the other variables values.

incomplete and inaccurate data sources (Weinberg 1998); ii) spatial auto-correlated data; and iii) modifiable areal unit problem (Holifield 2001). Qualitative analyses, on the other hand, focus on historical case studies that address the complex processes that lead to patterns of inequality in exposure to pollution. The historical analysis directly addresses the question of processes (George and Bennett 2005, 205), and causality. According to Mahoney (2004, 88), "causation is fundamentally a matter of sequence." The investigation of processes over time constitutes the central base for causal inference. Scholars approach the qualitative analysis of environmental inequalities from different perspectives, such as the role of planning practices (Pulido 2000), land use regulation (Boone and Modarres 1999), real estate dynamics (Been 1994; Lambert and Boerner 1997), industrial development, and demographic change (Szasz and Meuser 2000). In the literature the historical analysis or place-specific historical inquiry is considered to be an important approach to understand the present patterns of the distribution of industrial pollution and the process that created those patterns (Been 1994; Boone and Modarres 1999; Kreig 1998; Pulido 1996; Pulido, Sidawi, and Vos 1996). According to Szasz and Meuser (2000, 603), the historical approach, specifically that of local histories, has the advantage "to show interactions and interrelationships among industrialization, residential development and demographic development in all their complexity and specificity."

Space-Based Analysis - Quantitative Approach:

The quantitative analysis in this study uses space-based analysis to explore the relationship between poverty and the concentration of polluting facilities across the metropolitan space. The notion of space-based approach has been coined by geographers and implies that an observation's relative position on the space plane, its unique characteristics, and the effects generated by its relative proximity to other units, all have a direct effect on the relationships to be modeled. The exploration of spatial patterns could provide a link to other potentially interesting factors and to the context of the observations (Goodchild and Janelle 2004).

The objective of this exploratory research is to investigate the distribution of polluting industrial facilities in 12 partidos of the Metropolitan Area of Buenos Aires. This study uses the Geographically Weighted Regression (GWR) exploratory technique which provides an important method of identifying spatial heterogeneity, that is, the variation of the relationship between poverty and industrial concentration over the space. GWR is a widely employed technique in diverse fields like environmental studies and health; however, there are few examples of the use of GWR in this type of studies, as it is the case of the distribution of air toxic releases in New Jersey (Mennis and Jordan 2005). The GWR technique is discussed in more detail in Chapter 4.

Using the GWR the expectations are that: (1) GWR would describe the relationship between industrial density and poverty significantly better than ordinary least squares regression models (OLS);[16] (2) the localized regression coefficients developed for the socio-economic and other variables would exhibit significant non-stationarity; and (3) an examination of spatial patterns of the GWR regression coefficients would help to clarify the relationships between industrial density and socio-economic and location factors that might not have been evident in the global model. Given the diverse landscape of the AMBA, it expected that the relationship between industrial concentration and socio-economic characteristics of the population are not constant across the metropolitan space.

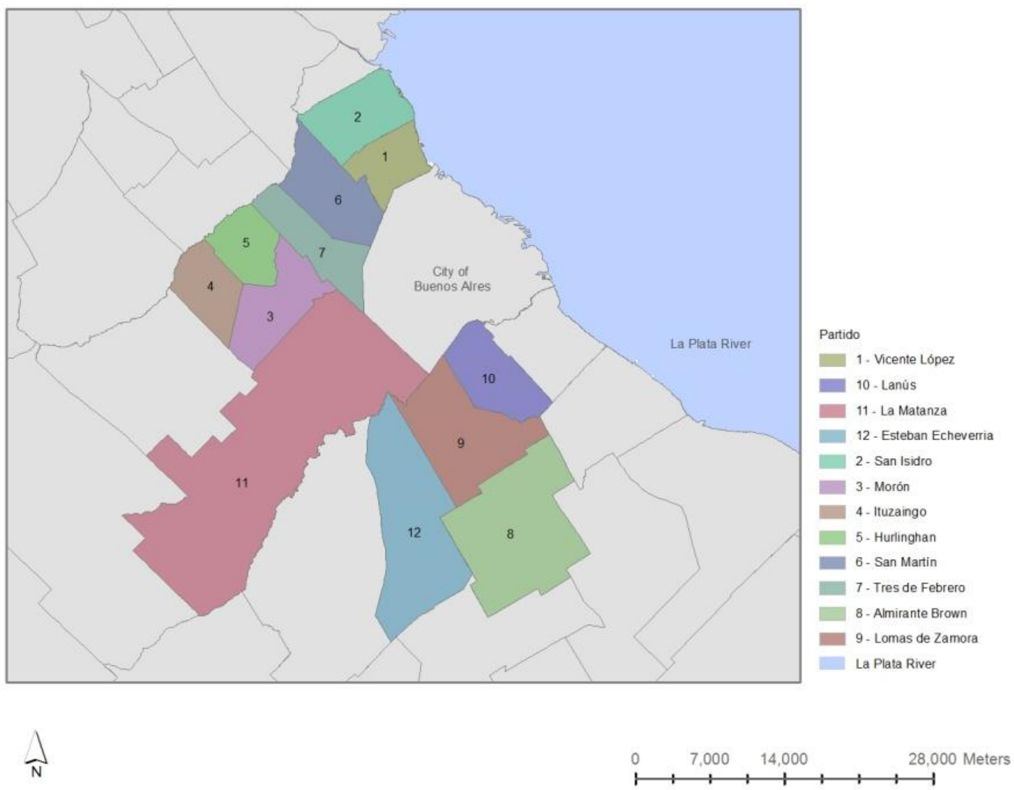
Data

The Metropolitan Area of Buenos Aires is defined as the City of Buenos Aires (CABA) and 24 partidos of the GBA that are located under the jurisdiction of the Province of Buenos Aires. According to the 2001 National Census, the Metropolitan Area of Buenos Aires concentrates almost 12 million inhabitants; 2,776,138 in the CABA and 8.864,867 are located in the 24 partidos of the AMBA (INDEC, 2001). This study analyses 12 partidos of the Greater Buenos Aires surrounding the CABA (see Map 2.1). These partidos are known as the 'first ring' of the metropolitan area. These partidos

[16] Comparison between the OLS and GWR models tests the null hypothesis that GWR represents no improvement over the global model.

concentrate a population of 5,004,152 inhabitants (INDEC, 2001). Only the partidos of the GBA were selected to control for the political jurisdiction of the province.[17]

Map 2.1. Area of Study



Georeferenced data on industries provides facilities location and industrial category according to their environmental impact. Industrial categorization is based on

[17] The city of Buenos Aires was not included since it is in a different jurisdiction with different regulatory framework regarding industries; consequently, the data on industries are not comparable between the two jurisdictions.

the type of materials involved in the industrial production, the quality and quantity of the effluents and emissions and the characteristics of the surrounding areas.[18]

According to the level of environmental complexity, industries are divided into these categories.[19] As table 2.1 shows, the level of environmental complexity identifies the level of risk associated with the type of facility. C3 facilities represent the highest risk to population's health and the environment.

Table 2.1. Industrial Classification according to the Level of Environmental Complexity

Category	**NCA[19]**	**Characteristics**
Category 1 (C1)	**≤11**	Industries that do not represent a risk for the population and do not cause any material or environmental damage. These are small size industries with less than 5 employees and a generation capacity lower than 15HP.
Category 2 (C2)	**>11** and **≤ 25**	Industries that provoke inconveniences because they disturb the population's healthiness or because they cause important damages on the properties or in the environment.
Category 3 (C3)	**> 25**	Includes industries that are dangerous because the pose a risk to the population's healthiness and cause serious damages on properties and the environment.

This study considers facilities with a level of environmental complexity (NCA) above the NCA score of 11; this includes the C2 and C3 industries because of the

[18] Ley de Radicación Industrial Nº 11,459 (1993) and Decreto Reglamentario 1741 (1993).

[19] The level of environmental complexity (NCA) is define as

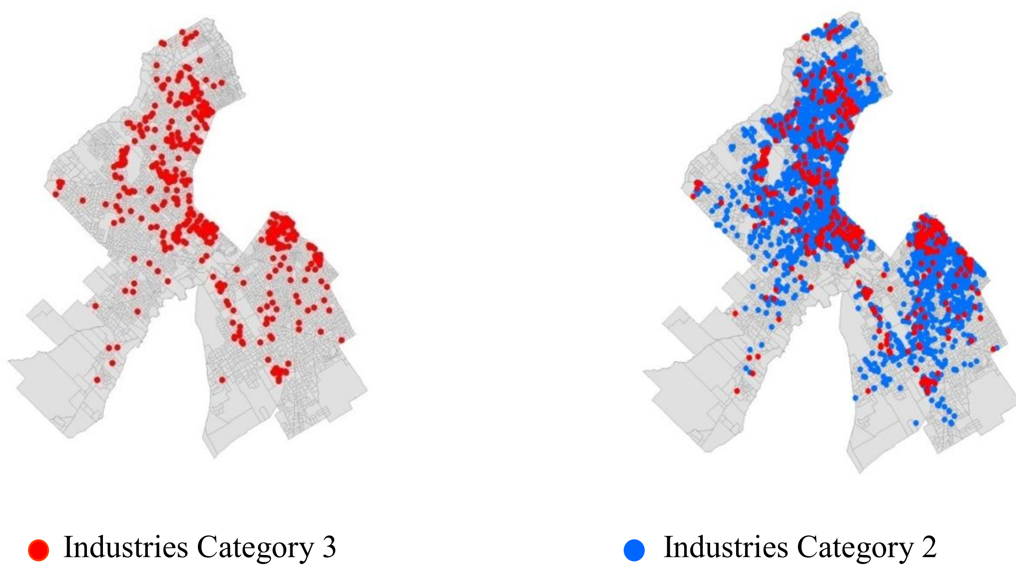
$$NCA = Ru + ER + Ri + Di + Lo,$$

where Ru is identifies the production sector which includes the type of materials and processing, ER is the quality of wastes and emissions generated, Ri is the potential risks posed by the activity such as fires, explosions, chemist, noise and technology. Di considers the industrial size and Lo takes into account the characteristics of the location that include municipal zoning and infrastructure's availability.

environmental risk that they pose to the population. After cleaning up the database; there are a total of 6756 Industries (C2 and 3), from which 6179 are C2 and 577 C3 (see Map 2.2). The data provide a sample of approximately 60 percent of the C3 industries and 80 percent of the C2 industries registered in 1998.

The 12 partidos host most of the industrial facilities in the AMBA. In the study area there are a total of 4,794 census tracts, and 1,843 tracts host either a C2 or C3 polluting facility; while 334 host at least one facility C3 and 1,779 host at least one facility C2.

Map 2.2. Spatial distribution of C3 and C2 Industries



The georeferenced data was developed in 2007 by the Departamento Sistema de Información Geográfica of the Dirección Provincial de Ordenamiento Urbano y

Territorial (DPOU) de la Provincia de Buenos Aires and contains the industries declared in 1998. Demographic data for the Buenos Aires Metropolitan Area was obtained from the 2001 Argentinean census. The data includes georeferenced data on railroads, roads and highways, rivers and land uses. All the georeferenced information was obtained from the DPOU.

The variables included in the models were constructed through calculations made by using functions within different software: Arc GIS 9.3 by ESRI, STATA 9, S Plus, and GeoDa 0.9.5-I by Luc Anselin (2004). Detail of the variables and estimation procedures is presented in Chapter 4.

Spatial-Temporal Analyses – Qualitative Approach

The main objective of the qualitative analysis is to understand the causes of continuity and change in the relationship between sources of environmental pollution and residents living in nearby areas; framed within the socio-economic, institutional and market theories. This study employs an historical analysis approach that considers external and internal factors as possible drivers of the neighborhoods trajectories. It argues that changes in the historical context shape actors perceptions and strategies. Considering the role of agency, the specific characteristics of the neighborhoods and their actors' capacities, resources and interests can lead to either reinforcing or gradual changes in the neighborhoods' trajectories over time. This approach frames the qualitative analysis to understand the causal mechanisms behind the observed spatial patterns.

Case study approach and case selection:

In order understand the processes and to explore the causal factors that shape the relationship between sources of environmental pollution and population, the qualitative analysis employs a case study approach. A case study is "a well-defined aspect of an historical episode that the investigator selects for analysis, rather than a historical event itself" (George and Bennett 2005, 18). The case study approach can use a single case, internal examination of single cases (within-case analysis) or a cross-case comparison within a single study. Case studies comparison provide "inferential leverage on complex causality" (Bennett and Elman 2006, 259). Furthermore, comparison between cases let us to identify the causes of similarities or differences among cases.

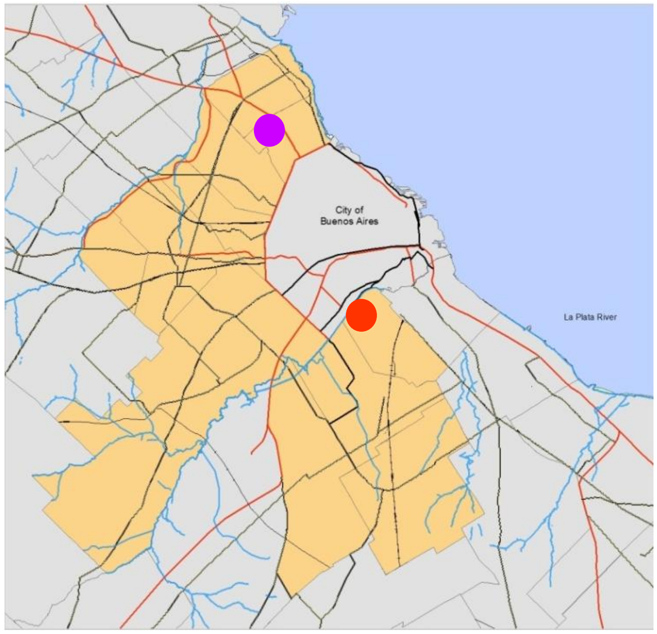
According to George and Bennett (2005), the strength of case studies approach lies on their advantages to hypothesis testing and theory development. Furthermore, case studies can also help to establish limits to generalizability (Stake 1998). These advantages are their potential for achieving high conceptual validity, strong procedures for fostering new hypothesis, exploring causal mechanisms and addressing causal complexity (George and Bennett 2005). Case studies also contribute to the understanding of the historical evolution because they allow for a holistic view of the history and a detail view of the events (Bennett and Elman 2006).

This study employs a cross-comparative analysis. The case studies were selected in terms of the dependent variable to explain differences in outcomes: selecting the cases according to variance in the dependent variable contributes to reduce selection bias (Collier and Mahoney 1996). As a frame of comparison these cases represent one negative and one positive case respectively. A case is considered positive when there is a high concentration of poor neighborhoods and high density of polluting industries, while a negative case is when there are middle-class neighborhoods exposed to high concentration of polluting industries. In the first – that of Munro, Partido of Vicente Lopez- the relationship between polluting facilities and poverty is negative; while in Barracas al Sur (Lanus) it is positive because there is a high concentration of poverty and industries. Both neighborhoods have the same land use and environmental regulation; high industrial densities and are located close to the city of Buenos Aires. One it is in the North –Munro-, and the other in the South -Barracas al Sur- (see Map 2.3).[20]

To assert the linking mechanisms that connect cause and effect the cases are historically analyzed to identify the changes in the neighborhoods trajectories over time, along with the factors that contribute to an increase or a reduction in the presence of polluting industries in each neighborhood.

[20] Munro covers an area of 104ha and Barracas al Sur 330ha.

Map 2.3. Case Studies location



Munro (Vicente López) Barracas al Sur (Lanús)

From a methodological perspective the neighborhoods' causal paths are analyzed using the process tracing technique; that is, local trajectories are analyzed by tracing the historical development of both neighborhoods in terms of urbanization and industrial development. Process tracing is defined as a "method [that] attempts to identify the intervening causal process - the causal chain and causal mechanisms - between an independent variable (or variables) and the outcome of the dependent variable" (George and Bennett 2005, 206). According to George and Bennett (2005, 137), causal mechanism are "unobservable physical, social, or psychological processes through which agents with causal capacities operate, but only in specific contexts or conditions, to transfer energy, information, or matter to other entities." Process tracing explains the outcomes of interest by going back in time and identifying the key events, processes, or decisions that link causes with the outcomes. A detail historical narrative traces and compares the sequence of events that form the process. This narrative chronologically analyzes the events, sequences and consequences, and provides an understanding of the actors' strategies.

Figure 2.1. Tracing the Causal Path

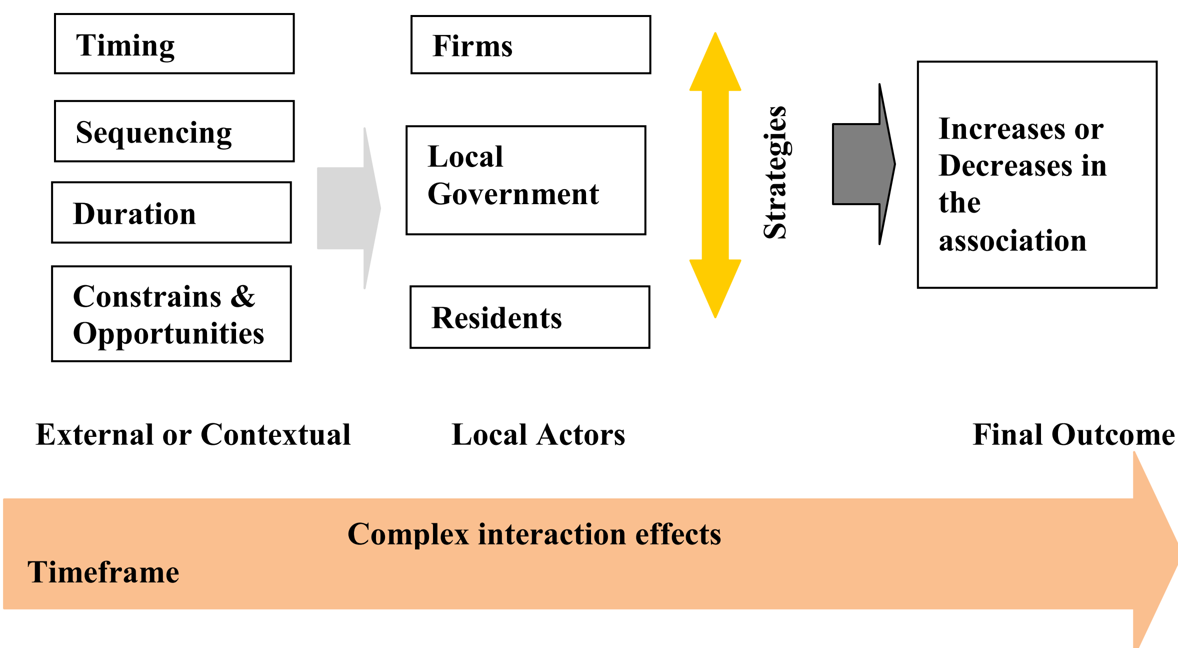


Figure 2.1 shows how the causal path (i.e., the process explaining the final outcomes) was traced in the case studies. The technique was implemented by: i) establishing a timeframe; ii) identifying relevant external or contextual factors that directly or indirectly affect the trajectory of the neighborhoods. The external factors consider the timing and sequencing in which they occurred and their duration, as well as constraints and opportunities that they imposed on the neighborhoods development; iii) identifying relevant local actors (i.e., firms, local government and residents); and iv), analyzing the interactions and strategies carried out by these entities. The causal path is characterized by complex interactions and effects that are constrained by external factors. The actors' strategies are determined by the limits and opportunities imposed by the context and the resources available to each actor. The confluence of these strategies determines the final outcome, that is, increases or decreases in the concentration of polluting industries and the poor.

Qualitative techniques

To address the historical development of the case studies three qualitative techniques were employed and include: i) photo-interpretation, ii) content analysis and iii) key informant interviews. The historical analysis was constructed in the triangulation of the information gathered by these techniques.

The spatial dimension of the territorial process of urbanization and consolidation was follow in a span of sixty years. This analysis was done by the photo-interpretation of aerial pictures from the ’60s, ’70s, ’80s, ’90s and 2008. The aerial pictures were obtained from the Dirección de Geodesia de la Provincia de Buenos Aires. The 2008 imaginary was obtained from Google Earth. To identify the spatial changes over time, maps containing residential and industrial land uses were developed for each decade in both case studies. Maps were draw using AutoCad software. To measure the evolution of residential and industrial land uses, the areas of each land use where estimated for each of the years in both neighborhoods.[21] Contextual information was gathered by conducting a content analysis from newspapers, blogs, books, legal claims and judicial resolutions.

To collect information about different actor’s perspectives, a series of key informant interviews were conducted between 2009 and 2010. Three main constituencies were interviewed: Public Officials from the Local government (Planning, Environment and Industry Agencies), residents and NGOs, and Local Chambers of Industry in each neighborhood. A total of 20 interviews were conducted on both neighborhoods. Several interviews were also conducted with specialist and academics. These semi-structured interviews focused on: i) the neighborhoods’ process of growth and industrial development, and current tendencies; ii) level of industrial pollution, health issues and environmental conflicts; and iii), the role played by the three different actors: residents, firms and government in that process.

---

[21] Industrial land uses include industrial facilities and storehouses.

CHAPTER 3:

THE HISTORICAL PROCESS OF DEVELOPMENT OF THE AMBA

Historically, Buenos Aires' urban form has been shaped by different economic and political processes that privileged the economic growth of the city of Buenos Aires over other cities and regions of the country. Political and economic decisions allowed the city to develop its comparative advantage, attract investment, concentrate political power, and manage Argentina's international trade. The presence of the port, important investments in infrastructure and the influx of immigrants and industrialization shaped the geography of the central city and the subsequent development of its metropolitan area. In this context the link between economic development, industrialization and urban growth processes shaped the relationship between industrial areas and population in the metropolitan city. In other words, the current metropolitan spatial outcomes are the resulting foot print of complex political and economic processes that developed over time. The purpose of this chapter is to provide a brief historical framework of the process of urban growth and industrialization of the metropolitan area of Buenos Aires. To that end, the chapter first analyses the industrial location patterns. Second, it reviews the historical process of urban development. Third, it describes different government urban plans and initiatives that attempted to shape the industrial location. These plans address some of the main environmental pollution issues affecting the metropolitan city and show the relevance of the topic throughout the city's history. Finally, it briefly discusses the emergence of the pollution control legislation and the environmental agenda.

THE METROPOLITAN AREA OF BUENOS AIRES

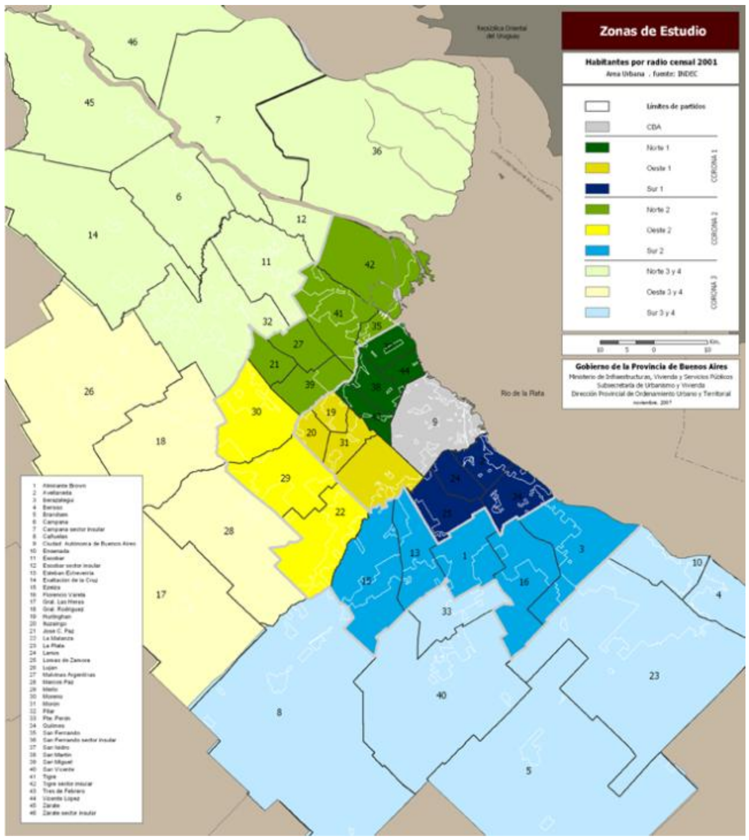
One third of Argentina's population resides in the Metropolitan Area of Buenos Aires. According the 2001 census the AMBA has 11.453.725, while the City of Buenos Aires has 2,776,138 and the Great Buenos Aires 8,684,953. The AMBA covers approximately 3,833 km^2.

The Metropolitan Area of Buenos Aires refers to the urban agglomeration comprising the City of Buenos Aires and 24 partidos (Municipalities/Counties) of the Great Buenos Aires. The metropolitan area is organized around the city of Buenos Aires. Map 3.1 shows that the Great Buenos Aires spread out from the city and is composed by a series of broadly concentric loops; with the first ring closer to the city, and so on.

The map shows that metropolitan area is composed by the city and the first and second ring, while the metropolitan region encompasses the up to the third ring, including 46 partidos. The conurbation spreads to the south, west and north of the city of Buenos Aires, while to the east the Río de La Plata serves as a natural boundary.

The population density of the Metropolitan Area of Buenos Aires follows that radial distribution, spreading from the high-density areas from the city of Buenos Aires and to the north. High density lines extend from the central core following the transportation infrastructure axes. Urban densities decrease towards the periphery.

Map 3.1. Metropolitan Area of Buenos Aires[22]



Source: Lineamientos Estratégicos para el Area Metropolitana
(Subsecretaría de Urbanismo y Vivienda 2007)

22 The first ring includes the partidos of Avellaneda, Lanús, Lomas de Zamora, Quilmes, Morón, Hurlingam, Ituzaingo, Tres de Febrero, San Martín, San Isidro and Vicente López. The second ring includes Berazategui, Florencio Varela, Almirante Brown, Estaban Echeverría, Ezeiza, La Matanza, Merlo, Moreno, San Miguel, Jose C. Paz, Malvinas Argentinas, San Fernando, El Tigre y Tigre Insular. Finally, the third ring encampases Ensenada, Berisso, La Plata, Brandsen, San Vicente, Cañuelas, Marcos Paz, General Las Heras, General Rodríguez, Luján, Pilar, Escobar, Insular Escobar, Campana, Exaltación de la Cruz, Zarate, San Fernando Insular, Campana Insular, Zarate Insular.

The metropolitan area is characterized by a political fragmentation. The metropolitan area does not constitute a single administrative unit. Competency over the metropolitan area is subdivided on several governmental bodies. This complex structure of government is composed by the Federal Government, the Province of Buenos Aires and the city of Buenos Aires. Furthermore, within the province there are 'partidos' (Pírez 2006). As we will discuss later, this political fragmentation imposes limitations in terms of urban planning and in addressing environmental issues.

Below we describe the process of urban growth for the whole metropolitan region in order to frame the historical context. It is worth mentioning that the quantitative analysis will focus only on the 12 partidos of the first ring, see Chapter 2 for the definition of the study area.

THE HISTORICAL INDUSTRIAL LOCATION PATTERNS

Throughout the 19th century up to 1930s, industrial activities were concentrated in the southern part of the city of Buenos Aires. Easy access to the Riachuelo River, the railway system and the port, and closeness to the markets were the driven factors for the industrial development of this area. The Riachuelo was a strategic location given the several advantages that offered to the meat processing industries such as water availability, a place for disposing wastes, and cheap transportation for final products (Shavrzer, 2000). In addition, the intersection of the Riachuelo and the railways permitted access to raw materials via the city's port, reaching both the internal and external markets.

The first industries were salting houses (*'saladeros'* or *'graserias'*) and food production for the internal market. Most of them were small factories (*'talleres'*) that used very basic and rudimentary technology. The salting houses processed meat and leather from cattle and became an important engine of the Buenos Aires' economy around 1820. At first this was to the domestic market, but after 1920 it expanded to reach foreign markets.

Urbanization followed industrial location, and the *'saladeros'* brought the first wage-earning urbanizations into their surroundings (Schvarzer 1996). The precarious mode of production, the unregulated disposal of waste in the river, together with the lack of basic services and the floods, had important environmental impacts on the Riachuelo affecting the population nearby (Schvarzer 1996). By 1822, to reduce the environmental degradation of that part of the city and the risks to public health, the government ordered the relocation of these industries on the southern margin of the Riachuelo, outside the city's boundaries (Defensor del Pueblo de La Nación 2003a). Despite these measures the city's pollution and poor services infrastructure caused a series of epidemics (cholera, 1866-1867, yellow fever 1871) which killed around 10% of the city's population -17,000 inhabitants-(Gutman and Hardoy 2006). In 1871, the government passed a new regulation that prohibited the location of salting houses either in the city or along the Riachuelo's margins (Defensor del Pueblo de la Nación 2003b).The yellow fever epidemic also had an important impact on the population distribution patterns. In search for better environmental conditions, the middle-upper classes gradually abandoned the south and central areas of the city, and relocate themselves to the north, leaving vacant houses for accommodating the new immigrants (Gutman and Hardoy 2006). This spatial re-localization of the upper social classes to the north of the city left a distinctive mark in the urban geography of Buenos Aires that remains present today.

The end of the 19^{th} century and the beginning of the 20th century marked the booming of the food related industries, especially those associated with meat processing –slaughter houses. Technological improvements opened up the external market for Argentinean products. The development of systems for refrigeration of food allowed the shipment of frozen meat to the European market. During this period there were also very important investments of foreign capital to develop the infrastructure needed to integrate the country into the world's economy. The objective of those investments was to expand the agricultural and food exports and services. Investments in infrastructure, such as railways, ports, transportation, sanitation and other public services favored the development of the city of Buenos Aires These investments determined the industrialization and concentration of economic activities in the Gran Buenos Aires – GBA (Rapoport 2005).

During this time, the industrial core started to consolidate in the south of the city (Barracas) and Avellaneda, around the intersection of the Roca railway line and the

Riachuelo (Schvarzer 1996).[23] This node provided access to both internal and external markets. It hosted food related industries, textiles industries and small workshops associated with these activities, as well as working class neighborhoods. The first meat processing plant, Sansinena La Negra (1885), was located in Avellaneda. By the beginning of the 20th century there were seven plants of big dimensions and three of them located on the Riachuelo's margin (La Negra, La Blanca and El Argentino). As the economy grew, industrial activities diversified to satisfy the internal market. New metallurgical and mechanical facilities began to scatter along the margins of the Riachuelo (Schvarzer 1996).[24]

The international crisis and the Great Depression of 1929 had a direct effect in the Argentinean economy and led to the country's industrialization. The sharp declined in primary products exports prevented from importing industrialized goods. This served as an incentive for the domestic production of industrialized goods and marked the crisis the agro-export model. Between 1930 and 1943 Argentina switched from the agro-export model to the import substitution industrialization model (ISI). ISI advocated replacing foreign imports with domestic production and economic development was state-directed and centrally planned. Furthermore, protective policies of the government towards the industry favored the influx of foreign capital. During its first stage (1930-1950), ISI was characterized by an import substitution process led by light industries - textiles, auto

[23] Until 1944, Lanus was part of Avellaneda.

[24] It is worth noting, however, that during this time most national industrial sectors were not able to satisfy the growing domestic demand. In fact, with the exception of foods and beverages, imports surpassed domestic production in most industrial sectors (Rapoport Mario 2005).

industry, and electrical machineries. These industries did not need complex technology or important sums of capital and demanded intensive labor (Rapoport 2005). In this context, the Great Buenos Aires became the center of the Argentine's industrialization because it concentrated the biggest and the most important market in terms of high purchasing power for industrial products. In addition the city offered abundant labor and transportation and communication infrastructure; it had an easy access to and from the rest of the country as well as to the foreign market (Jorge 1971; Rapoport 2005). For all these reasons, the import substitution model reinforced the centrality of the capital city and its metropolitan area in relation to the rest of the country.

During the 1950s and 1960s new industrial sectors started to develop with state support and foreign capital. In this second stage of the ISI model the focus was on the development on 'heavy" industries (also known as basic industries) such as chemical, oil refineries and derived products, iron and steel industries, transportation and electrical machinery, these industrial sectors had an important share in the Argentinean economy of that time (Rapoport 2005). In the context of the industrialization process promoted by the ISI model, the spatial patterns of industrial location in Buenos Aires started to change slightly. After the 1930s, while the south of the central city and the south of the GBA still concentrated most industrial facilities, some industrial activities started to disperse to the northern and western parts of the metropolitan area (Gutman and Hardoy 2006). Furthermore, as industrial production increased industrial clusters became more specialized an located in specific neighborhoods; for instance, Avellaneda hosted oilrefinery activities, Lanus leather factories, Munro and San Martin textile industries (Schvarzer 1996).

According to the industrial census of 1941, the central city concentrated 300,000 employees, while the industrial belt of the Gran Buenos Aires only had 110,000 employees, most of them working in facilities located in the partidos of the South (Avellaneda, Lanús and Valentín Alsina). This tendency changed by the 1960s; by 1964, the city had a similar share of industrial employees as the metropolitan area: 365,944 against 369,495 employees in the city. By 1974, the city slightly reduced the number of industrial employees - 344,925- and the metropolitan area clearly outnumbered it - 520,340- (Secretaría de Estado de Transporte y Obras Públicas 1977).

The development of a new transportation infrastructure played a key role in the industrial location patterns. Between 1870 and the 1930s the railway system had shaped the metropolitan structure favoring the development of industrial cluster in the south of the central city and the GBA (Subsecretaría de Urbanismo y Vivienda 2007), but by 1940, the railway system had collapsed. For this reason, unlike the previous period, these new industries did not follow the railways. Instead, industrial location was tied to the paved road system and later, after the 1960s, to the highways system (Gutman and Hardoy 2006). Those industries that were not able to locate on the new infrastructure system occupied the interstices between them, forming the GBA industrial belt around the city of Buenos Aires (Secretaría del Consejo Nacional de Desarrollo 1969).

During this period, the metropolitan area of Buenos Aires (AMBA) also faced unprecedented urban growth. This process included the densification of the central city and a significant expansion of the city into the periphery to accommodate the influx of immigrants. As the city grew, new industries and urbanizations began to overlap in the periphery of the central city and in the GBA. The increasing demand of urban land to host the new population limited the available land for industrial uses. As a result, industries and factories started to establish in locations that were more distant, but still had good accessibility to the central city.

By 1960 the industrial belt was consolidated in the first ring that surrounds the central city and around the Riachuelo and Resistencia river basins (Subsecretaría de Urbanismo y Vivienda 2007). The industrial spatial pattern clearly changed showing a strong tendency of industrial location in the north corridor (Schvarzer 1996). The *"partidos"* of the South still showed an important concentration of industries containing about 30% of the total industries located in the metropolitan area, but their share was smaller compared with the 50% that they had in the 1940s (Gutman and Hardoy 2006). By 1970 there was a further dispersion of industries beyond the traditional industrial belt of the GBA. Big industrial plants started to locate further from the GBA in the North corridor following the Acceso Norte and the Zarate-Campana corridor that provided accesses to other ports, besides that of Buenos Aires. The urbanization also grew in that direction following the industries and created an urban continuum between the central city of Buenos Aires and other industrial cities in the north up to the Parana River. This tendency was also reinforced by metropolitan plans that conceived the AMBA as a part of a regional industrial system.

The second part of the 1970s marked a turning point in the economy of the Buenos Aires metropolitan area. The ISI model was abandoned. Changes in the economic model including import tariff reductions and liberalization of the credit market and the interest rate led to a deep process of de-industrialization. In addition other policies implemented during the military regime also contributed to the deindustrialization of the AMBA, the development of the service sector in the city of Buenos Aires was encouraged. The de-industrialization of the AMBA was accompanied by policies that provided incentives to the development of the service sector in the city of Buenos Aires and policies that promoted the relocation of industrial activities in less industrialized provinces.[25] Moreover, the process of de-industrialization deepened during the 1990s with the neo-liberal reforms and the opening of the domestic market to foreign imports. In this context, traditional industries tend to disappear while new industries began following new spatial location patterns. This tendency followed the modernization and extension of the existing and new transportation infrastructure which created new processes of industrialization and urbanization (Fritzsche and Vio 2002; Fritzsche and Vio 2005). New industries decided located in industrial clusters and industrial parks in

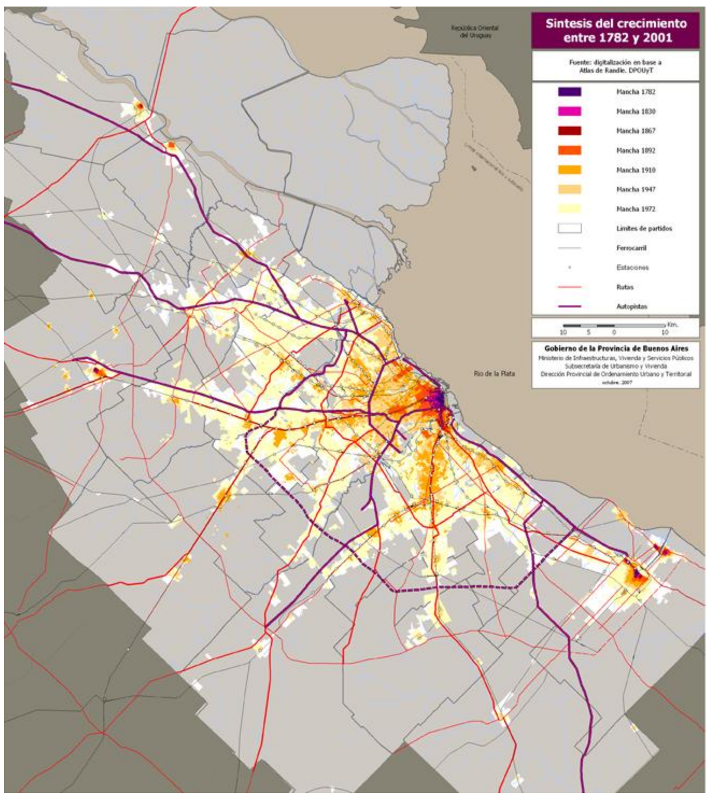
[25] The industrial promotion law (*Ley de promoción industrial*) in 1979, promoted the de-centralization of the industrial production by granting subsidies for the relocation of industries in less industrialized provinces, like San Luis, Catamarca and San Juan. According to Schvarzer (1996) A primary objective of the spatial redistribution of industrial activities was to disperse the concentration of labor from the main industrial cities in order to avoid social conflicts.

peri-urban areas mainly in the north of the metropolitan area (Subsecretaría de Urbanismo y Vivienda 2007). At this point, industrialization was no longer a main factor in the process of urbanization of Buenos Aires (Fritzsche and Vio 2002). As mentioned above, the p*artidos* that had the greatest industrial share were mainly concentrated in the first ring (Avellaneda, San Martín, San Fernando, San Isidro and Vicente López), and some partidos of the second ring (Ministerio del Interior 1995). As a consequence of this process of de-industrialization, the first ring of the AMBA became an 'industrial cemetery', characterized by abandoned industrial facilities and some old industries that have few chances of modernization (Bozzano 1999; 2000).

URBANIZATION OF THE METROPOLITAN AREA

The process of urban growth followed a radio-centric distribution from the central city. Map 3.2 shows that the urbanization grew from the central city along the La Plata River and extended into the periphery following the main transportation lines. As can be seen, before the 1950s the city was rather compact, and after the 1950s the first and second ring were consolidated. From the 1980s to the present the metropolitan area extended towards the third and fourth ring. As the city of Buenos Aires grew, new industrials and residential areas advanced over the periphery. However, the characteristics of these new residential areas and the quality of the urbanization differed substantially across the territory, marking spatial inequalities regarding the level of access to public services, housing and the different environmental conditions of the new neighborhoods. Even though, in many cases, the accessibility to services and neighborhoods' environmental conditions improved over time, the initial stages left important and enduring marks in the urban geography of the metropolitan city.

Map. 3.2. Historical Process of Urban Growth



Source: Lineamientos Estratégicos para el Area Metropolitana (Subsecretaría de Urbanismo y Vivienda 2007)

From 1930 to 1970 industrialization was the most important determinant of urban expansion and transformed Buenos Aires into a metropolis. Industrialization generated significant labor opportunities in the city and this fueled massive rural-urban migration. This migration flow contributed to rapid urban growth, population concentration, and territorial expansion of the metropolitan area. The size of Buenos Aires local market together with good communication and transportation infrastructure, access to the port and to international trade, and the city's political power created comparative advantages for the city and its metropolitan area, and favored the location of industries and attracted population to Buenos Aires.

By the 1940s the AMBA concentrated 60% of Argentina's industrial plants (Schvarzer 1996). As a direct consequence of the city's economic growth, the population influx caused the expansion of the city, beyond its historical geographical limits, in all directions: South, West and North. Up until the 1960s industrialization was the driving factor of urbanization of the periphery of the central city and the consolidation of the Great Buenos Aires (Fritzsche and Vio 2002; Gutman and Hardoy 2006; Schvarzer 2000)

Following the literature that analyzes the process of urban growth of Buenos Aires from an historical perspective, the urban development of the metropolitan area can be roughly divided into three main periods. The first period goes until the 1930s, and it was based on the agro-export model. This period was marked by the centrality of the Buenos Aires city and its port. The second period goes from 1940s to 1960s. This stage was marked in economic terms by the import substitution model and the welfare state in political terms and by the crisis of the welfare state and the establishment of the neo-liberal policies by the military regime in 1976 (Torres 2006). The third stage goes from the end of the 1970s to the present. This period is characterized by the neoliberal policies of the middle 1980s and 1990s, during which the neo-liberal reforms deepened, and de-regulation opened-up the economy (Pírez 2006). We will present a brief description of the process of urban growth.

Until the 1930s, the Southern part of the city was the area most heavily populated. Urbanization followed the location of the industries along the Riachuelo and Rio de La Plata margins (Schvarzer 2000). At that time the socio-spatial structure of the metropolis was defined by three areas: North, West and South, all of them located in a radius of 9 km from downtown. In this urban structure, the North sector of the city concentrated the high income population (Torres 2006).

This spatial pattern changed during the 1940s and 1950s. During those decades the metropolitan population increased significantly due to new waves of immigrants, who were no longer coming from Europe this time (the European immigration flows ended with the economic crisis of 1930), but from the poorest and more rural Argentine provinces, attracted by the industrial development and employment opportunities offered by Buenos Aires (Gutman and Hardoy 2006). In spatial terms, the massive suburbanization of these new waves of working class immigrants during the 1940-1950s, caused a dramatic expansion of the periphery. This feature marked the new socio-economic distribution of the population in the metropolitan territory. While the low income population occupied the periphery, doubling their distance from downtown (18 km), upper and middle class kept the proximity to the central city, living near the center toward the north (Torres 2006). The urban growth process was characterized by the urbanization of the periphery of Buenos Aires, consolidation of the first ring and the densification of the central city (Subsecretaría de Urbanismo y Vivienda 2007).

This spatial pattern of urban growth was also shaped by the development of new infrastructure and the industrial expansion over distant areas of the south and northern areas of the AMBA (Pírez 1994). This marked the consolidation of the industrial belt in the first ring that surrounds the city of Buenos Aires. Some working class neighborhoods developed in the north part of the metropolitan area such as San Martín, Munro, Villa Adelina, etc., and irregular settlements developed in the South, occupying marginal land and lacking basic infrastructure and services (Sociedad Central de Arquitectos 1955). At this point it is worth stressing how the relationship between industrialization and urbanization changed during the 1940s, 1950s and 1960s. During the early stages of the process of industrialization, the location of industrial workers coincided with the industrial areas; industries were the main factor of urbanization; industries provided employment and brought urban services to areas that have plenty of vacant land to be developed (Facciolo 1981). This relationship between industrial location and worker residences began changing during the 1940s. By the 1960s, the development of the suburban land market provided access to housing in more distant location. These houses were cheaper given the lack of basic services, and were affordable by monthly installments. As a consequence of the development of this new land market, workers located in more distant areas from the industrial areas and in less industrialized partidos (Facciolo 1981)

This socio-spatial pattern was also a consequence of the state's active role in the field of economic and development policies that encouraged income distribution (Gutman and Hardoy 2006). Governmental policies promoted the massive suburbanization of the AMBA by developing transportation infrastructure and by policies that made easier the access to housing to the lower economic sectors of society. Transportation policies helped the development of the suburbs through subsides that reduced transportation tariffs and costs (Pírez 1994; Torres 2006). These policies were also a mechanism to subside and to facilitate the access of urban workers to land. In contrast to the active role of the state promoting economic and social policy, the land market was characterized by lack of government regulation and laissez-faire policies. In other words, the fast process of urban growth developed during the 1940-1960s was largely carried out without land regulations and governmental control. Consequently, the urbanization of the periphery lacked basic services infrastructure and many settlements and neighborhoods occupied flooding and marginal land (Pírez 1994; Torres 2006) The urbanization of the periphery was mainly done by low income population by two strategies: '*loteos populares*' (popular subdivisions) and, near to the city center, the "*villas de emergencia"*. These strategies provided easy and low cost access to home ownership in the periphery and reinforce the income distributional policies (Cravino 2008). The *'loteos populares'* were legally developed in low quality land without infrastructure and limited accessibility.

Meanwhile, the *villas* offered an alternative for the population excluded from the housing market, and basically they were illegal occupations of vacant land close to the center (Pírez 1994). The *loteos populares* were developed at a massive scale in the periphery while the *'villas de emergencia'* developed on public vacant land in the central city, and in the first ring and along the Riachuelo River (Torres 2006). During the 1970s, the development of *villas* in the south of the metropolitan area was reinforced by the eradication of *villas* carried out by the military regime in the city of Buenos Aires. These eradication actions were conducted by the military government without any program to relocate the expelled population. Consequently, the number of new villas increased in the south near the Riachuelo and in several *partidos* of the metropolitan area such as Lanus, Avellaneda, Lomas de Zamora and Quilmes (Gutman 2006 [referencing Yunosky 1984])

The changing patterns of the spatial distribution of population had different rates in the central city and in the periphery. These patterns coincided with the densification of the central city and the massive suburbanization of the periphery, while historically the central city had concentrated most of the population, during 1960s the Gran Buenos Aires over passed the central city's population. At that time the AMBA concentrates 35.4 % of Argentina's population. Since the 1960s to the present, the central city has tended to lose population, while in the GBA population has doubled almost 9 million in 2007.

From the 1980s the urban structure started to change with the development of new types of irregular settlements the "asentamientos", the suburbanization of upper-middle class sector), and the deterioration of the central area (Torres 2006).

New types of irregular settlements the "asentamientos" were developed in the GBA. The asentamientos are illegal land occupations with a spatial subdivision that imitates the formal city, this type of subdivision made possible the subsequent regularization. The development of these asentamientos responded in part to the eradication of the villas from de central city and to the economic situation that limited to access to housing to the poor. Furthermore, there was an involvement of NGOs and the church that gave support to these groups and the attitude of the provincial government to regularize those settlements (Torres 2006). Meanwhile, the suburbanization process of the upper middle class was characterized by the development of gated communities, sometimes located at more than 40km from the city of Buenos Aires, largely towards the north (Torres 2006).

During the 1990s the new urban pattern became increasingly complex and fragmented (Janoschka 2002).The privatization of the transportation infrastructure improved the accesses to the central city and the role of private developers in the construction of urban amenities and land development (Pírez 2006) contributed to define an urban structure constituted by multiple "islands" of land-uses. The metropolitan patchwork is constituted by areas of: production (industrial spaces); gated communities; commerce (shopping centers); and poverty cells (Villas) surrounded by low income residence (Janoschka 2002).

Metropolitan Planning and Regulations

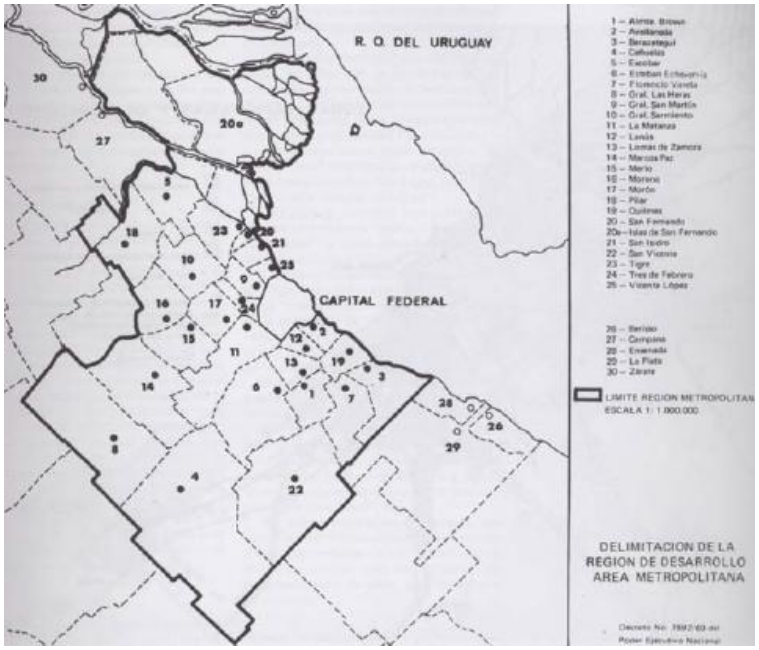
From 1958 several plans and regulations intent to delineate the land use planning and development. These plans were proposed by different levels of government that included: the federal government, the city of Buenos Aires and the Province of Buenos Aires. The implementation of these plans was limited due to political constraints and jurisdictional overlaps. Most of the plans were only partially developed, and some of them were not implemented at all. However, they constitute an extremely useful source to understand the existing patterns of industrial land uses and development in the metropolitan area, and how the different governments attempted to address the industrial distribution of land uses and sought to modify some of those patterns. Furthermore, most of the plans and regulations promoted the relocation of industrial uses and constrained their development on the first ring of the AMBA. The older plans (CONADE, SIMEB) followed the comprehensive or systemic planning while the latest (Lineamientos) shifted to a more strategic kind of planning. Despite the differences between their methodological approaches, all of them addressed the conflictive issue of the development of industrial areas in the AMBA. Below, we present a brief overview of the main governmental regulations and planning initiatives focusing on their proposals regarding industrial land uses and the urban environment. In the final section we present an overview of the emergence of the environmental legislation and agenda from 1990s and onwards.

1958. Plan Director para la Ciudad de Buenos Aires. This plan was developed by the municipal government of the city of Buenos Aires and addressed metropolitan and regional issues. The *'Informe Preliminar, Etapa 1959 -1960'* recognized the unbalanced growth of the metropolitan area. As a consequence of the lack of planning, the metropolitan area presented many structural problems. The plan proposed to balance the metropolitan development of Buenos Aires by encouraging a lineal growth along the coast of the Rio de la Plata. Some of the environmental problems of the AMBA are recognized. For this reason the Plan Director recommended to control urban expansion and to stop the occupation of low level land and flooded areas. It also proposed the clean-up of the polluted river basins of Matanza and Reconquista (Municipalidad de la Ciudad de Buenos Aires 1968).

In relation to industrial development, the plan recognized the imbalance concentration of industries in the AMBA respect to the rest of the country. Given the high concentration of the industrial activities in the AMBA, the plan proposed the dispersion of the industrial activities throughout the Argentine territory. New industries should be oriented toward the development of 'natural industries' favoring their location in the interior of the country close to the sources of agriculture products. This measure would stop the internal migration towards the AMBA and would limit the industrial concentration. Despite its detailed analysis and proposals, the plan was not implemented, once of the main constrains was that it was developed because by municipality of Buenos Aires which had no competence at the metropolitan scale (Suárez 1994).

1966-1970 El Plan del CONADE. Esquema Director para el año 2000. In 1966, during the military regime, the national government created the Oficina Regional del Area Metropolitana (Regional Agency of the Metropolitan Area) under the authority of the Consejo Nacional de Desarrollo Económico (CONADE). This office was in charge of developing the Esquema Director para el Año 2000. For the CONADE, and for the military government, regional planning was part of a strategy of national development (Pírez 1994). This was the first governmental initiative that conceived the metropolitan area as a region. The region was composed by the city of Buenos Aires and 25 p*artidos* of the GBA, see map 3.3 (Subsecretaría de Urbanismo y Vivienda 2007). The Esquema Director recognized the de facto urbanization process of the AMBA. The Plan proposed to guide urban and industrial growth along with the development of new transportation infrastructure, such as the highway system. The plan projected a lineal development of the metropolis from La Plata to Rosario along the La Plata River.

Map. 3.3. CONADE. Delimitation of the Region of Buenos Aires



Source: Esquema Director para el Año 2000, CONADE (1969).

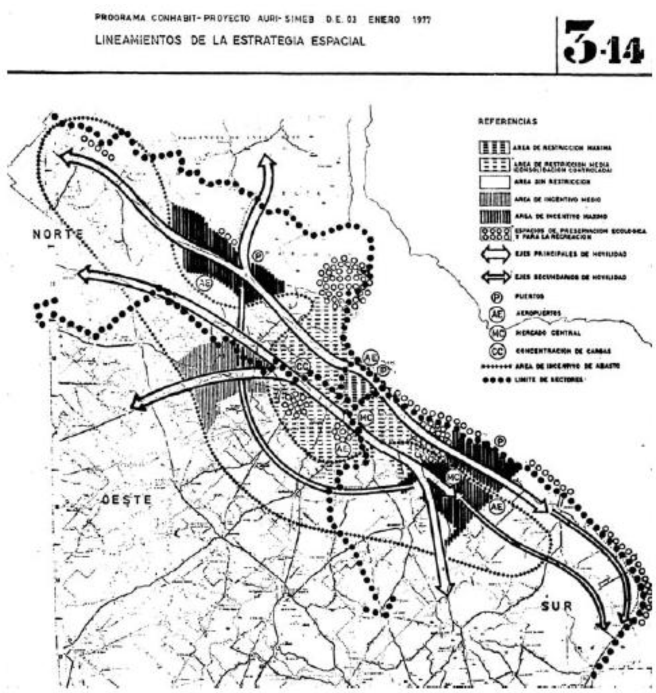
Regarding the spatial location of industrial activities, the plan recognized that the concentration of industries in the first ring responded to a spontaneous process that had created conflicts between industrial and residential land uses. While some industries had a tendency to cluster around specific activities in areas like the Riachuelo, San Justo, San Martín and Munro, others were scattered throughout the suburbs. Accordingly, the plan proposed the spatial deconcentration of industries by the creation of a system of new industrial areas interconnected trough a new transportation system to the main regional centers. The plan also limited the presence of industries in highly dense residential areas of the city. According to the plan, these new regulations imposed upon the existing industries would limit their expansion, and prevent the siting of new ones in, which would move to new designated areas (Secretaría del Consejo Nacional de Desarrollo 1969). Furthermore, the plan proposed the dispersion of “disturbing” industries farther from the traditional industrial *partidos* towards the North and the South following the incipient patterns of industrial location. The plan represented an effort to transform the urban structure, but required a very high level of investments in transportation and infrastructure (Suárez 1994). Despite the plan’s strong rationality and the authoritarian conditions in which it was created, its proposals were not implemented (Torres 2006).

1975-1977 Sistema Metropolitano Bonaerense SIMEB. Following CONADE’s plan, the military regime developed the Sistema Metropolitano Bonaerense SIMEB (1975-1977). The SIMEB set the basis for the military regime’s urban policy to control the territory (Subsecretaría de Urbanismo y Vivienda 2007). It defined the metropolitan area as a fluvial-industrial system that included territories of the north, south and west, like Gran La Plata, Brandsen and Lujan (see map 3.4). Based on a systemic approach, the plan framed the action of planning as a continuous process of analysis and formulation of urban policies that even included public participation.

In relation to the issue of metropolitan governance, the plan recognized that the overlap of jurisdictional competencies between national, provincial and municipal governments posed problems of coordination and management of the metropolis. This was considered the main reason why policies lacked a global vision to address the metropolitan complexity (Secretaría de Estado de Transporte y Obras Públicas 1977). In this regard the plan proposes the creation of a metropolitan agency (Ente Metropolitano), although it did not define a specific model.

In relation to the spatial distribution of industrial activities, the plan proposed the decentralization of industrial activities along the fluvial axe and into other provinces, as the CONADE had previously proposed. Even though its original objectives were distorted, this plan had the greatest impact in the metropolis (Subsecretaría de Urbanismo y Vivienda 2007). In fact it set the basis for several regulations regarding land use that specifically addressed industrial location and urban development, and attempted to promote the development of the service sector, regulate urban growth, and limit the industrial uses in the AMBA.

Map 3. 4. Sistema Metropolitano Bonaerense: Spatial Strategy.



Source: Lineamientos Estratégicos para el Area Metropolitana
(Subsecretaría de Urbanismo y Vivienda 2007)

Código de Planeamiento Urbano para la Ciudad de Buenos Aires and Law 8912 (1977). This Code promoted the development of the services sector and the densification of the central city. Meanwhile, the main objective of the provincial law 8.912 was to set the basis for the planning process and zoning. The law gave the municipalities the legal jurisdiction to formulate and issue their zoning regulation and local plans. The provincial law regulated zoning and determined the occupation of land, and required basic services and public facilities for approving new urbanizations. These measures improved the urbanization conditions but also caused increases in land value and limited the availability of low cost land for low income population. Consequently, during this period, there were almost no new developments of *loteos populares* or informal settlements in the AMBA (Pírez 1994 [referencing Clichevsky 1987]).

Concerning industrial land uses, law 8.912 allowed industrial clusters within other land use areas, only when the effects on the environment, accessibility, and infrastructure and services availability were taken into account. The laws explicitly indicated that polluting activities must be located in rural areas or in industrial parks, which provided the necessary services and infrastructure for these activities.

General Ordinance 259 (1977). During the military regime there were attempts to diminish the economic and demographic concentration in the AMBA and to improve the environmental conditions of the metropolis. In 1977, the provincial government passed the general ordinance 259, which established that 13 industrial sectors must be moved from 29 *partidos* of the GBA in a period of ten years. This regulation was framed as a measure aiming to address the regional industrial unbalance within the province of Buenos Aires, and based upon previous attempts of prior plans to address the problems of the metropolitan area. At that time the metropolitan area concentrated 77% of the provincial industries and 66% of the province's population (Oszlak 1991). This provincial regulation prohibited the location of new industries in a radii of 70 km from the limits of the central city as an attempt to force the existing industrial facilities to relocate in defined industrial areas (Subsecretaría de Urbanismo y Vivienda 2007).

Industrial Location Law (1979). Along with provincial regulations, in 1979 the federal government passed the law 22.021 (Ley de Radicación Industrial) that created tax incentives and subsides for the relocation of industrial plants in less industrialized provinces. Some authors question the environmental and territorial imbalance arguments used to justify this law. According to Schvarzer (1996) the policies applied during the military regime conceived industrial concentration as a source of potential social conflict. It is for this reason that the government promoted the relocation of industries from the main industrial cities (like AMBA, Córdoba and Rosario) to less developed provinces. Pollution control was also used as an excuse to eradicate industries from the AMBA because issues such as waste treatment were not addressed, while on the other hand, the new regulations promoting industrial relocation established a maximum number of workers per industry (Schvarzer 1996).

The effects of the relocation policies in the AMBA were limited; however, mainly because the provincial government did not have economic resources to finance the process, and all investment needed to relocate the industries had to be faced by the firms (Oszlak 1991). Moreover, many business and industries strongly opposed to move to other locations and gradually the government postponed the application of these measures. The provincial government granted exceptions and imposed some measures that tended to lessen the environmental pollution of the existing factories (Pírez 1994). As a consequence, the central city lost an important number of industrial workers and the partidos of the South, such as Avellaneda and Lanus, lost more than 20% of industrial workers. These measures had a direct repercussion on spatial terms because changed the historical process of industrial concentration along the Riachuelo River in the south of the AMBA (Schvarzer 1996). In sum, the re-location legislation did not cause a diminished number of existing industries, but it broke the historical tendency of industrial concentration in the AMBA (Pírez, 1997). This law was revoked during the 1980s by the new democratic government.

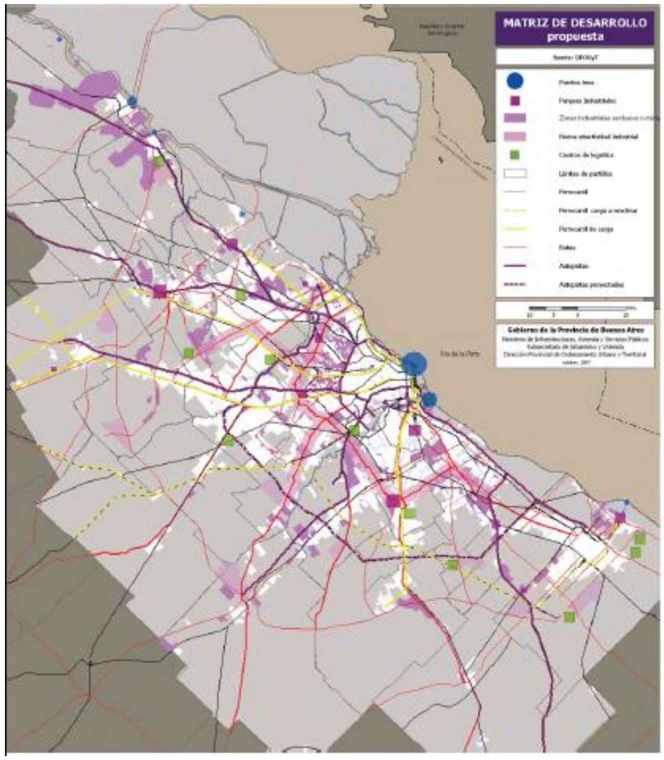
CONANBA (1984). The new democratic government created the CONAMBA (Comisión Nacional del Area Metropolitana) by federal decree in 1984. The CONAMBA included the capital city and 19 partidos of the Buenos Aires province. This was an attempt to coordinate different governmental areas that have jurisdiction over the metropolitan area of Buenos Aires. The CONAMBA proposed the economic reactivation of the metropolis by adapting industries with adequate technology and specialized labor. The Commission argued that one of the main challenges to guarantee the necessary conditions for industrial development was the creation of new industrial parks (CONAMBA, 1995). However, the CONAMBA's attempts to coordinate and design planning proposals failed given its lack of political leverage (Pírez, 1994).

Lineamientos Estratégicos para Región Metropolitana de Buenos Aires (2007). In order to address the territorial and productive organization of the Metropolitan Region of Buenos Aires the provincial government developed the Strategic guidelines for the Metropolitan Region of Buenos Aires (Subsecretaría de Urbanismo y Vivienda 2007). The strategies were developed by the Undersecretary of Urbanism and Housing of the

Buenos Aires province in order to and address the most pressing problems and their effects in the whole metropolitan region (Garay, 2007). The metropolitan region included the city of Buenos Aires and 40 partidos of the Buenos Aires Province.

Unlike previous comprehensive plans, the Lineamientos did not constitute a plan in itself. Instead, it proposed lines of actions and prefigures alternatives scenarios and their consequences for the future development of the metropolitan region. By taking into account the different actors that participate in the definition of the urban policies it constituted a more realistic approach to the governance limitations of the metropolis. Regarding economic development the plan recognized that the metropolis have several weaknesses. These weaknesses are related to energy problems, congestion of the port and transportation system, and to the obsolescence of the industrial neighborhoods (Subsecretaría de Urbanismo y Vivienda 2007). These factors limit the AMBA's competitive advantages for the location of new economic activities. Therefore, the Lineamientos proposed the creation of new industrial parks, as well as a new network of transportation infrastructure that would let industrial and logistic activities to spread into the second ring close to the higher labor demand (see Map 3.5).

Map 3.5. Lineamientos Development Matrix



Source: Lineamientos Estratégicos para el Area Metropolitana
(Subsecretaría de Urbanismo y Vivienda 2007)

THE EMERGENCE OF THE ENVIRONMENTAL AGENDA.

As mentioned above, pollution problems and issues have been always present in the historical development of the metropolitan area. However, the environmental activism and the development of environmental policy became more visible and relevant since the 1990s. Many factors help explaining the emergence of the environmental agenda and activism during this period. Particularly significant is the reform of the Argentine constitution in 1994, which recognizes the right to a healthy environment (art 41 of the Constitution). Moreover, the constitutional reform also provides legal standing to NGOs and affected parties to bring legal claims to the courts for violations of environmental rights (art. 43), which proved to be a relatively efficient way for local groups to get the state attention in relation to issues of environmental pollution and degradation.

During the 1990s there was a significant development of environmental legislation and pollution control regulations in the metropolitan area of Buenos Aires issued by the national, provincial and local governments. However, the shared view among experts, activists and local residents is that the level of enforcement of the pollution control regulations had been generally low and insufficient (Defensor del Pueblo de la Nación 2003b; Fundación Ciudad 2002). For many observers, a main obstacle to improve pollution control in the metropolitan area is the absence of clear institutional responsibility among the different levels of government (World Bank, 1995) the institutional framework for environmental control involves a web of overlapping federal, provincial and municipal agencies. This results in an unusually complex system of regulations and authorities that opened up many opportunities for polluters to avoid compliance with environmental objectives.

In relation to the environmental activism, social awareness and demands about the environmental issues and problems affecting the metropolitan area increased significantly since the 1990s. However, collective action over environmental issues is still very fragmented and localized. Social protests and mobilizations tend to be reactive and focalized, for instance, after specific events of pollution or flood affecting specific areas of a river basin (see for instance, Lanzetta [2003] and Ryan [2004]) . Other examples are the collective actions conducted in Munro regarding industrial pollution (discussed later in Chapter 5). Moreover, after some time, broad popular attention and mobilization usually languished, leaving only a small number of local residents or associations working on and following up the issues. Furthermore, collective actions and demands had tended to be territorially focused (addressing a particular environmental emergency affecting certain neighborhoods), and there is a low level of articulation among local associations and neighbor groups mobilized around these issues in different parts of the metropolitan areas. In short, the lack of a coordinated and sustained collective demand over the socio-environmental problems affecting the metropolitan area greatly limited the political leverage of the local groups demanding policy changes on this issue.

DISCUSSION

This chapter shows how the development and growth of the city of Buenos Aires and its metropolitan area has been closely linked to the process of industrialization. The availability of employment opportunities attracted migrants from the rest of the country making Buenos Aires the biggest urban agglomeration in Argentina to the present. The urban growth was shaped by the development of transportation and service infrastructure, industrial and residential areas. The characteristics of the processes of urban growth vary over time and spatially, favoring or disfavoring the development and quality of the urbanization in different areas of the city.

In the process of urban growth the development of industrial areas in conjunction with residential areas were the driving factors for the urban expansion. During the early stages of the process of industrialization, industrial areas were located near to the city center, but this location pattern has changed throughout the years. In the last 40 years, new industries have tended to locate further from the city's core and from the original industrial areas. Industrial land uses were considered an important part of urban plans and land use regulations; with different levels of impact most of them coincided with the need to relocate the industries from the old locations in the first ring of the AMBA. Despite all the changes described, the early industrialization still has direct consequences on the AMBA and on the neighborhoods located near to those facilities. These conflicts involve plants that are still operating in the area, as well as the remaining of old industrial facilities. Today, there are high levels of industrial concentration surrounding the central city and have not been many technological improvements oriented to the waste treatments; consequently, the AMBA has important problems of environmental pollution. This overlap of industrial facilities and residential areas causes land-use conflicts. Furthermore, industrialization also left behind abandoned industries with environmental liabilities that represent a threat to the population's health. Finally, in terms of environmental inequalities, the lack of adequate sanitation in poor neighborhoods makes them more vulnerable to the environmental effects of pollution.

CHAPTER 4

MODELING THE SPATIAL VARIATION OF POLLUTION AND POPULATION DISTRIBUTION

This chapter analyzes the relationship between industrial sources of pollution (measured as the density of polluting industrial facilities) and poverty as well as segregation (among other factors) in 12 partidos of the Metropolitan Area of Buenos Aires (AMBA). The analysis combines analytic and exploratory techniques, each based on relevant theories developed by the literature and informed by detailed data analysis at the census tract level. The first component of the quantitative approach is an analytic methodology that uses global regression models. The second component is more exploratory in nature and studies the spatial variation of this relationship in the metropolitan space.

Much of the existing research, conducted primarily in the United States, analyzes the global relationship between population and stationary sources of pollution and conceives the exposure to pollution in terms of the presence or absence of polluting facilities. This methodological approach has two main limitations: i) it does not consider the spatial variation of this association; and ii), it ignores the continuous impact of pollution and neighborhood effects. To overcome these limitations, this research uses Geographically Weighted Regressions (GWR) to model the distance decay effects of pollution and tests for spatial non-stationarity following the methodology proposed by Mennis and Jordan (2005).[26]

The relationship between the concentration of polluting industries and population distribution is recognized as a dynamic socio-spatial phenomenon (Pulido 2000). By modeling local variation, it may be possible, therefore, to identify critical areas where the presence of the poor may explain the concentration of polluting sources. Accordingly, the exploratory models used in this study to test for spatial variation account not only for key socio-economic variables associated to the presence of industrial facilities but also for the urban structure.

This chapter first introduces the exploratory techniques and the concept of spatial non-stationarity. Second, it presents the Geographically Weighted Regression (GWR) model calibration and explains the results of global and local models. Finally, it discusses the main findings and limitations of this approach to explain the relationship between poverty and environmental outcomes.

EXPLORATORY MODELS

Models in the social and geographical sciences almost always have some degree of error and do not fully capture the processes under study. These models are approximations of reality as it is unlikely that they can capture complexly the complexity of social processes (Longley et al, 2005). Since it is not possible to capture every single

[26] Notice that in the introduction the terms 'stationary' and non-stationarity' sources referred to fix or mobile sources of pollution. In this section 'non-stationarity' refers to the spatial variation of the relationship between industrial density and explanatory factors.

aspect of a causal relationship, at every possible scale, in a digital format, any spatial representation of social phenomena is likely to be selective and incomplete, and as a result, some degree of uncertainty is inevitable (Longley and Tobón 2005; Longley, Goodchild, Maguire, and Rhind 2005). Uncertainty is defined "as a measure of the user's understanding of the differences between the contents of a dataset, and the real phenomena that the data are believed to represent" (Longley, Goodchild, Maguire, and Rhind 2005, 128). The sources of uncertainty in Geographic Information Systems (GIS) arise from measurement errors, inaccuracy, ambiguity, and vagueness; models using spatial data present some degree of uncertainty.

Spatial analysis techniques represent an important tool in both inductive and deductive approaches to science (Goodchild and Janelle 2004). On one hand, following the inductive approach, the spatial distribution of the data may expose patterns and anomalies, and suggest processes that may account for them. On the other hand, spatial analysis may be used to test theories. However, given its nature as an exploratory technique, spatial analysis is more appropriate to generate hypothesis and insights than to confirm theories (Goodchild and Janelle 2004; Longley, Goodchild, Maguire, and Rhind 2005). In any case, the goal of spatial analysis is to generate knowledge about processes influencing spatial patterns (Fotheringham, Brunsdon, and Charlton 2000).

The quantitative analysis in this study uses a space-based approach to analyze the extent to which global models (such as Ordinary Least Squares) are able to describe or capture the phenomena under analysis. Moreover, exploring spatial patterns may provide a link to other potentially interesting factors that help to explain spatial variation (Goodchild and Janelle 2004) in the relationship between polluting industrial facilities and population in the AMBA.

Spatial Variation

The nature of spatial variation depends on the proximity effects and the unique characteristics of space as well as the geographic scale of analysis. Spatial dependency and heterogeneity are two aspects of spatial variability (Anselin and Griffith 1988). Tobler's Law states that "everything is related to everything, but near things are more related than anything else" (Tobler 1970). This statement recognizes that observations' spatial distribution and proximity make them no longer independent, and captures the spatial regularity known as the distance decay relationship (Wong 1995). In other words, "spatial dependency is the extent to which a value of an attribute in one location depends on the value in nearby locations," describing the similarity of nearby observations (Fotheringham et al. 2002, p. 14). This dependence refers to the existence of a functional relationship between events in the space (Anselin and Griffith 1988; Anselin 1988). In a positive spatial autocorrelation closer objects are similar in both location and attributes leading to form spatial clusters, while in the negative spatial autocorrelation objects that are close together in space are dissimilar in attributes than those that are more distant. When there is no spatial autocorrelation attributes are considered independent of location (Longley, Goodchild, Maguire, and Rhind 2005).

Conversely, spatial non-stationarity pertains to the lack of uniformity of the effects of space (Anselin 1988), that is the spatial or regional differentiation which follows from the uniqueness of each location (Anselin 1992). Non-stationarity refers to the variation of a given phenomena in terms of form and processes with respect to location; the relationship between two variables varies in different places. As the spatial data exhibit an increased range of values heterogeneity will increase with the distance

(Longley, Goodchild, Maguire, and Rhind 2005). The notion of spatial heterogeneity is related with non-stationarity which is a property of the modeled relationship rather than the data and refers to the tendency for any relationship to vary spatially.

Other reasons for spatial variation refer to the scale of analysis. “A major shortcoming of all areal measures is that they obscure the underlying location pattern through spatial aggregation and the imposition of arbitrary administrative boundary definitions” (Sweeney and Feser 2004, 12). This problem is known as the Modifiable Areal Unit Problem (MAUP), and it refers to the effects of scale of analysis or boundary definition and the level of aggregation that can influence the analysis and modeling results (Sweeney and Feser 2004; Wong 1995 [referencing Openshaw and Taylor 1979]). Thus, cross-sectional data are sensitive to the way in which the spatial units are organized (Anselin 1988). On one hand, the scale effect pertains to the inconsistency of analytical and statistical results derived from data represented at different levels of spatial resolution for the same area; on the other, the zoning or the aggregation effects relates to the inconsistency of analytical and statistical results derived from data from the same region, but aggregated or regrouped in different manner (Fotheringham, Brunsdon, and Charlton 2002; Wong 1995). In other words, different combinations of a given number of geographic individuals into a coarser-scale areal unit can yield widely different results (Longley, Goodchild, Maguire, and Rhind 2005).

Global Versus Local Models

Urban processes are generally locally dependent and tend to be non stationary, this means that they vary over the space. This variation can be explained through local factors such as: accessibility, historical processes, regulation, etc. While differences across space are emphasized by local statistics, global statistics stress similarities across space. Global models equally calibrate the data from across the study region and show average relationships across the study area and do not distinguish any representative situation. Local statistics on the other hand are a spatial disaggregation of global statistics. Local statistics are multi-valued and can vary according to different locations. Each local statistic is a measure of the attributes or the relationship under study in the vicinity of a location within the study area; consequently, as the location changes, the local statistics can take different values (Fotheringham, Brunsdon, and Charlton 2002).

As mentioned above, non-stationarity is a property of the modeled relationship rather than a characteristic of the data. Considering the uniqueness of space (spatial heterogeneity) it refers to the tendency for any relationship to vary spatially (Osborne, Foody, and Suarez-Seoane 2007). The variation in the parameter estimates can be attributable to: i) different relationships across the space; ii) sampling measurement; and iii), model misspecification. One explanation for spatial variation of a given relationship refers to the fact that "some relationships are intrinsically different across space;" that is, the relationship is non-stationary (Fotheringham et al. 2002, p. 9). Such spatial differences can be a consequence of people's attitudes or preferences, or different administrative, political or contextual factors that produce different responses to the same stimuli over space (Fotheringham and Brunsdon 1998; Fotheringham, Brunsdon, and

Charlton 2000). Sampling variation and data calibration, relates more with methodological procedures rather than with the nature of the spatial process: random sampling variation will cause spatial variation in observed relationships. Misspecification can reflect spatial variation of a given relationship as a consequence of the omission of relevant variables or incorrect representation of the functional form. In those cases in which there is misspecification due to omitted variables in global models, local models incorporates these omitted effects into the model through locally varying estimates (Fotheringham, Brunsdon, and Charlton 2002). One interesting feature of these exploratory techniques and local models is that they can help to build more accurate models, since if local variation is present in the relationship under study they can suggest more accurate model specifications or the nature of such variation. Furthermore, as mentioned above, these place-based or local models can be used to test hypotheses and provide insights to understand spatial patterns and processes.

MODELING SPATIAL HETEROGENEITY:

Geographically Weighted Regression (GWR)

The underlying assumption of the global OLS regression model is that the relationship under study is spatially stationary (i.e. independent from the spatial location), and thus the estimated parameters remain constant over space. However, relationships that exhibit spatial non-stationarity create problems for the interpretation of parameters estimates of the regression model (Fotheringham and Brunsdon 1998). GWR is a modeling approach that extends the traditional regression framework by allowing local rather than global parameters to be estimated. GWR model's assumption is that coefficients are not random, but rather that they are a deterministic function of their location in the space (Fotheringham, Brunsdon, and Charlton 2002). Thus, GWR allows local rather than global parameters estimates. Instead of specifying one single model to capture the relationship under study (i.e., between industrial density and socio-economic characteristics of the population) in the entire study area, GWR estimates a separate model for each observation based on its relative location and tests for spatial non-stationarity.

Consider the following global model that estimates (global) parameters regardless of their location in space:

$$Yi = \beta_0 + \sum_k \beta_k X_k + \varepsilon_i. \qquad (1)$$

Consider also the following GWR model that allows for local parameters estimates:

$$Y_i = \beta_0 (u_i, v_i) + \sum_k \beta_k (u_i, v_i) X_{ik} + \varepsilon_i, \qquad (2)$$

where (u_i, v_i) denotes the coordinates of the ith point in space and $\beta_k (u_i, v_i)$ is a realization of the continuous function $\beta (u, v)$ at a given point i. GWR produces a set of location-specific parameter estimates that can be mapped and analyzed in order to provide information on about the extent of non-stationarity in relationships (Fotheringham, Brunsdon, and Charlton 2002). The GWR technique is basically a moving kernel window approach that computes localized regression estimates (Brunsdon

1999).[27] The GWR procedure yields a separate model for each spatial location in the study area being all the models generated from the same dataset using a differential weighting scheme (Byrne, Charlton, and Fotheringham 2009).

The model calibration is done using a spatial weight matrix that defines a window or bandwidth, within the bandwidth observations are weighted according to a distance decay function; beyond the bandwidth all observations have zero weight. In the bandwidth selection there is a bias-variance trade-off because if the regression coefficients vary continuously over the space, it is unlikely to provide completely unbiased estimates for each observation. Conversely, if only close observations are considered, the effective sample size will be reduced and the estimates of the standard errors will increase (Brunsdon 1999). The results of GWR are sensitive to the bandwidth because this can exaggerate or soften the degree of non-stationarity. The bandwidth controls the distance-decay in the weighting function and indicates the extent to which the resulting local calibration is smoothed (Fotheringham, Brunsdon, and Charlton 2002); as the bandwidth increases, the parameters estimate will tend to estimate smoother results (Brunsdon 1999) close to a global model (Wang, Ni, and Tenhunen 2005).

The estimated coefficients are a function of the bandwidth of the spatial kernel used, i.e., the radius or the number of observations around each point included in the weighting matrix (Brunsdon, Frotheringham, and Charlon 1998). The kernel bandwidth may be fixed or adaptive. The fixed kernel bandwidth establishes a fixed moving window

[27] In estimating a parameter at location *i,* GWR runs a regression using a subset of the points in the dataset close to *i*; for every location *i* a new subset of 'nearby' points is used, and so on, measuring the relationship inherent in the model around each location *i.* Under the assumption that parameters exhibit spatial consistency, closer observations will have similar values and signs while observations farther from point *i* will have more likely differing coefficients. Each observation is weighted according to its proximity to *i*, observations closer to *i* are weighted more than those farther away; consequently the weighting of an observation is not constant, but varies according to the location of point *i* (Fotheringham, Brunsdon, et al 2002).

in shape and magnitude, and once defined the weight remains constant and is applied uniformly across the space despite the distribution and density of observations in the area under study. As a consequence of its constant characteristics, the fixed bandwidth presents problems in regions where the data are dense and the kernels are larger than they should be; and in this case the estimates are more likely to suffer from bias. In the opposite, in regions with scarce data with kernels smaller than they should be, the estimate parameters are likely to be inefficient.

The adaptive kernel function offsets the fixed kernel problem by allowing the bandwidth to vary based on the number and density of observations. The spatially adaptive weighting function will have relatively small bandwidths in areas were the data points are densely distributed and relatively large bandwidths were the data points are sparsely distributed (Fotheringham, Brunsdon, and Charlton 2000). The selection of the weighting function and bandwidth can be determined using a cross-validation (CV) approach or Akaike Information Criterion (AIC) (Fotheringham, Brunsdon, and Charlton 2002).

In GWR, the selection of the weighting function and optimal bandwidth are accomplished by minimizing the corrected AIC, which indicates how close a regression model approximates reality, and it accommodates for differences in the number of degrees of freedom in the models compared (Fotheringham, Brunsdon, and Charlton 2002).[28] Another test for comparison between the global and local model is the ANOVA

[28] As a rule of thumb, comparing two models, improvements in AIC that are less than 3 in value could be due to of sampling error, while values greater than 3 are more likely to be due a genuine difference between models (Fotheringham, Brunsdon et al. 2002).

that tests the null hypothesis that the GWR model represents no improvement over a global model (Charlon, Fotheringham, and Brunsdon 2010).

Regarding the spatial variability of the local estimates or the non-stationarity relationship modeled, several tests are used to determine if the variation in the GWR results are due to a genuine spatial drift in the parameters, or whether they are caused by random fluctuations in the models' error term. The variability of local estimates can be used to examine the plausibility of stationary assumption held in traditional regression (Fotheringham, Brunsdon, and Charlton 2002). Estimates to test the significance of spatial variability in local parameters is calculated by using the Stationarity Index and Monte Carlo permutation test (Charlon, Fotheringham, and Brunsdon 2010; Fotheringham, Brunsdon, and Charlton 2002).[29] The Monte Carlo test examines more formally the significance of the spatial variability in the local parameter estimates: if spatial variation is not statistically significant it is probable that variation occurred by chance.

The GWR creates a geographic surface of models with localized parameters estimates, standard errors, t-values and local R-square which can be mapped to visualized spatial patterns. The calibration procedure in GWR uses the same data set to calibrate separate models at each spatial location, but this creates a certain degree of dependency between the models. As a consequence of this dependency, the t statistics and associated hypotheses tests are inflated creating the multiplicity problem (Byrne, Charlton, and

[29] The Stationarity Index is an ''ad hoc'' test for the degree of spatial non-stationarity in a relationship by comparing the range of local parameters estimates with a confidence interval around the global estimate coefficients. This is measured by comparing the range of values between the lower and the upper quartiles with the range of values at +- 1 standard deviations of the respective global estimates, that is, 2 x S.E of each global estimate. Given that 68% of the values would be expected to lie between the later intervals, compared to 50% in the interquartile range; the relationship might be non-stationary if the interquartile-range is greater than 2 standard errors of the global mean (Charlon et al. 2010).

Fotheringham 2009). Fotheringham's adjustment overcomes the multiple inference problem by establishing the critical t-value is a proportion to the number of degrees of freedom in the GWR model (Fotheringham 2010; see Appendix 2).

Finally, regarding the spatial variation effects mentioned above, spatial autocorrelation and modifiable areal unit problem, GWR provide some advantages compared with global models. According to Fotheringham et al. (2002), allowing non-stationarity in the regression parameters can account for part of the autocorrelation in the global model calibrated with spatial data. GWR by modeling continuous spatial processes instead of using discrete zones and by assuming spatial non-stationarity may not be as influenced by the MAUP as traditional global regression. This is due to the model calibration procedure that does not assume a certain scale of analysis a priori, but rather estimates the surface points based the close neighbors, consequently there is a greater likelihood that each point belongs to a region with similar characteristics (Fotheringham, Brunsdon, and Charlton 2002).

Model's Specifications

Following Equation 2, I denote Y_i as industrial density, X_{ik} as a vector of independent variables that includes a measure of poverty and segregation among other control variables, and (u_i, v_i) denotes the coordinates of the *ith* point in space. Two different measures of industrial density are employed in the models. The first denotes the industrial density of Category 3 (DC3) industries; the second represents the industrial density of Categories 2 and 3 combined (DC2&3) (see Chapter 2 for a description of the industrial categories). In the following section we discuss the estimation procedure of industrial density.

Table 4.1 shows that for each dependent variable different univariate and multivariate models were developed. Each Model was run using the OLS and the GWR. Comparison between the OLS and GWR models tests the null hypothesis that GWR represents no improvement over the global model.

Table 4.1. OLS and GWR Models

<table>
<tr><th></th><th>Model</th><th>Dependent Variable:
Industrial Density</th><th>Independent
Variables</th></tr>
<tr><td rowspan="2">Univariate</td><td>Model 1</td><td>Category 3 (DC3)</td><td rowspan="4">Poverty
Segregation[30]
% Industrial Land Use
Distance to Roads
Distance to Railroads
Distance to Rivers
Urban Density</td></tr>
<tr><td>Model 2</td><td>Categories 2 and 3 (DC2&3)</td></tr>
<tr><td rowspan="2">Multivariate</td><td>Model 1</td><td>Category 3 (DC3)</td></tr>
<tr><td>Model 2</td><td>Categories 2 and 3 (DC2&3)</td></tr>
</table>

The models' calibration was achieved by using an adaptive bandwidth. The adaptive bandwidth expands in areas where industrial density is scarce and contracts in areas with high concentration of industrial facilities. This bandwidth offers a better fit to

[30] Segregation was estimated using the LISA (Local Indicator of Spatial Autocorrelation).

the spatial distribution of industrial density in the AMBA that is highly concentrated in areas close the urban core, and more sparse at the outskirt of the study area. To test the significance of spatial variability in local parameters the Stationarity Index and Monte Carlo permutation test were estimated. Furthermore, to overcome the multiple inference problem this study employed Fotheringham's adjustment that establishes that the critical t-value is a proportion to the number of degrees of freedom in the GWR model (Fotheringham 2010).[31]

To capture and control for the urban structure of the metropolitan area, several proximity variables were included in the models (see Table 4.1 and map 4.6).[32] These variables are: distance from the urban center, proximity to major highways and cargo railways, as well as distance to rivers. These variables were created by measuring the distance from each spatial feature to the centroid of each census tract. The effects of industrial clusters are measured as a percentage of industrial land use in the census tract.[33] Population density is used as a proxy for urban concentration and was estimated as the total population divided by the area of the census tracts (persons/km^2).

---

[31] The Fotheringham's adjustment value estimated for this study was 2.8.

[32] Geographic processes play a major role in the distribution and density of industrial facilities; corroborated by the literature as well as for the case specific of the AMBA. Historically, accessibility factors have played an important role in the spatial location of economic activities because they provide access to raw material and access to markets. Furthermore, the geographical characteristics of the territory have promoting the location of certain types of industries in proximity to rivers because they provided water for production processes, a medium for transportation of materials and products, and a convenient sink for discharging wastes products (Bolin, B., A. Nelson, et al. 2002). The role of the river basins in the historical process of industrialization in the AMBA was discussed in more detail in the previous chapter (Chapter 3).

[33] Land use is a key explanatory factor because industrial location (Morello-Frosch, Pastor, et al 2001;Pastor, Sadd et al. 2004); rather than being and individual facility decision, it involves land use planning and zoning, and industrial clusters (Boon, Modarres 1999; Morello-Frosch, Pastor et al. 2001; Pastor, Sadd et al. 2004).

Poverty was measured using the households' material deprivation index (IMPH) provided by the National Census 2001.[34] The households that present structural and convergent poverty were included in the model because they capture a more permanent condition of poverty. Segregation was included as an independent variable to capture the association of clusters of poverty and industrial density. It was estimated by using LISA (Local Indicator of Spatial Autocorrelation)[35] following previous studies on urban segregation (see: Flores 2008; Groisman and Suárez 2009; Torres and Bichir 2009). For statistical reasons all the independent variables were normalized using the natural log for those variables that measure accessibility and distances, as well as, poverty following the literature (Mennis and Jordan 2005; Pastor, Sadd, and Morello-Frosch 2004).[36]

---

[34] The IMPH measures poverty based on different types of deprivation and their intensity. This index identifies different degrees of poverty according to the household's insufficient economic capacity (Privación Corriente) and patrimony (Privación patrimonial). The IMPH classifies poverty into four categories: 1) no poor; 2) insufficient economic capacity 3) structural poverty; and 4) convergent poverty (Gómez, Mario et al. 2003). The IMPH refers to household's insufficient economic capacity (2) as the relationship between the number of formal education of those that receive income and the total number of people in the household. This type of poverty is not necessarily permanent, but varies over time mainly a consequence following economic cycles. Structural poverty (3) is defined in terms of material deprivation that considers the households' material characteristics and sanitation. This patrimonial deprivation affects the households in a more stable manner and persists over time (Gomez A. et al. 2003). The last category, convergent poverty (4) refers to the households that combine both, insufficient economic capacity (2) and structural poverty (3).

[35] Local Indicators of Spatial Association (LISA) indicate the presence or absence of significant spatial clusters of poverty at each location. It indicates how similar one neighborhood is to surrounding neighborhoods. The neighborhood for each observation is formalized by means of a spatial weights or continuity matrix (Anselin 1995). In this study the spatial weight matrix considers a first order queen continuity. Segregation was measured using the households' material deprivation index (IMPH).

[36] Other variables considered in similar studies are percent of residents employed in manufacturing and land values. Percent of labor force in manufacturing reflects the notion that industries and their employees tend to be cluster near one another (Sadd, Pastor, et al. 1999; Pastor, Sadd et al. 2004). Land values are an important factor that explained the location of polluting because such activities tend to locate where land values are the lowest (Sadd, Pastor, et al. 1999). Information regarding these variables is not available at the CT scale for the AMBA.

PROXIMITY MEASURES OF EXPOSURE TO HAZARDS

Studies that address the distribution of polluting sources using a descriptive or quantitative approach use mapping techniques, spatial statistics, univariate and multivariate regression analysis to test the hypothesis that environmental inequalities exist. A key issue is how to define how to measure exposure to sources of pollution. Scholars employ different strategies to measure residential proximity to hazardous sites and risk. The literature identify (Downey 2006; Mohai and Saha 2006) three broad categories, that are: i) the Unit Hazard Coincidence method; ii) the Buffer or Distance Based Methods; and iii), the Pollution Plum Modeling.

i) The Unit-Hazard Coincidence method has been the classic approach and the most widely used in the environmental inequality research for assessing demographic disparities in the distribution of environmental hazards. In this method a predefined geographical unit of analysis (such as census tract, zip code area or municipality) is selected, and the neighborhoods that host a polluting facility are identified; then demographic differences between host and non host units are compared. Although measured in different ways, such as number of hazards or sum of pounds of pollutants emitted in the unit of analysis or a dummy variable identifying the presence-absence of hazardous facilities; this method basically considers the spatial coincidence between the hazards and the host unit (Mohai and Saha 2006).

The Unit-Hazard Coincidence method poses several methodological limitations in its approach. First, it confines negative effects only to the host unit and assumes that the effects are evenly distributed within it. Second, it does not consider the specific location of the facilities and their nearby effects; for example, even though facilities are often located near the boundaries of several census tracts, this method does not take into account the hazards' effects in the tracts nearby treating them as non-host (Sheppard, Leitner, MacMaster, and Tian 1999).

ii) The Buffers or Distance Based methods unlike the Unit-Hazard Coincidence methods have been used in a limited number of studies (Mohai and Saha 2006). These buffer methods (Downey 2006) are use to determine the area of a hazard's impact and the population affected by it. In this method the precise location of environmental hazards are located in a map and their distances to nearby population are specified by circular buffers around each facility. The population living within the predefined buffer distance is consider to be exposed to industrial pollution (Sheppard, Leitner, MacMaster, and Tian 1999). These buffers then are matched to the areal units of analysis.

While some scholars have used buffering to identify population at risk from point sources (Sheppard, Leitner, MacMaster, and Tian 1999; Walker, Mitchell, Fairburn, and Smith 2005), others scholars use the Distance Based Methods to model the distribution of environmental hazards by defining a density index (Bolin, Nelson, and Hackett 2002; Mennis 2002). In their study of Maricopa County, Arizona, Bolin et al. (2002) developed density index by first producing a composite hazard map of four key point-source hazards in Phoenix's metropolitan area. The demographic composition of census tracts that host and do not host hazardous facilities is analyzed for each hazard. Next, they develop and test an approach that allows for the assessment of the cumulative risk in census tracts, based on radius zones of one mile (1.6 km) around each hazard site for each of the four types of hazards. These multiple overlapping hazard zones are scored and summed for each census tract, and the value standardized by the total area of each tract. The resulting cumulative hazard density index (CHDI) provides an aggregate hazard score for each tract, which is then correlated with demographic data to measure levels of environmental inequity.

Mennis and Jordan (2005) address equity in the distribution of stationary sources of pollution in New Jersey. The study analyzes the facilities reported by the EPA whose emissions were greater than zero pounds of air toxins released: TRI (Toxic Release Inventory) and also differentiates the PBT facilities (Persistent Bioaccumulative Toxins). These chemicals are considered particularly dangerous given their propensity to remain in the environment over long periods of time and accumulate in body tissues. The study approach is based on the distribution density of TRI and PBT facilities within each census tract. The authors argue that by using facilities' density captures the clustering of hazardous facilities and account for the fact that facilities lying near the borders of the census tracts affect nearby areas. Both of these studies have the advantage of modeling a continuous surface considering the distance decay effects of pollution.

iii) The last technique is the Pollution Plume Modeling technique that use air pollutant concentration and toxicity data to estimate risk scores (Downey 2006) taking into account factors such as wind speed, wind direction, air turbulence, smokestack height and rates of chemical decay and deposition (Sheppard, Leitner, MacMaster, and Tian 1999; referencing Ash and Fetter 2004) . The main limitations of these techniques are that health risks are not only associated with pollution exposure and data availability is limited. Furthermore, given the complexity of the data involved, these models often entail simplifying assumptions which can lead to erroneous results (Sheppard, Leitner, MacMaster, and Tian 1999). In the present study this technique has not been considered because this information does not yet exist in Argentina.

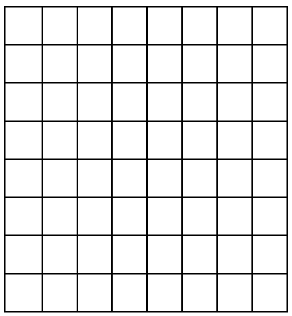
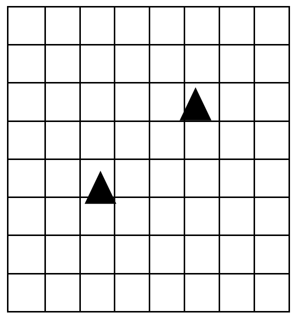
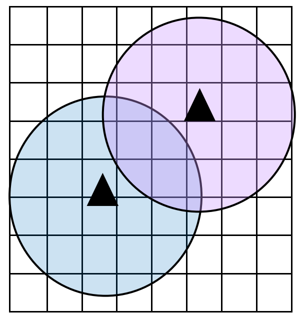
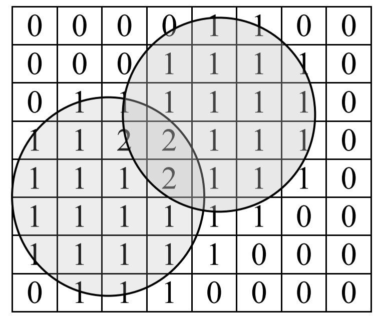
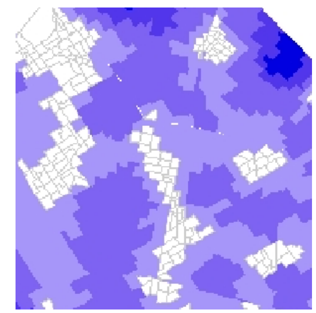
Estimating Industrial Density

This study employs Distance Based Methods to model a continuous surface of the distance decay effects of pollution, following the studies of Mennis and Jordan (2005) and Bolin et al. (2002). This approach has two main advantages: i) by capturing industrial clusters in a continuous surface it considers the neighbors' effects of such facilities in surrounding census tracts and across jurisdictional boundaries; and ii), it also models the distance decay effects of pollution. Industrial density was estimated at the census tract level (Figure 4.1. illustrates this estimation procedure). First, a 30-meter resolution grid containing 1,150,855 grids was created to cover the total area of the 12 partidos of the metropolitan area (Column 1 in Figure 4.1). This grid was then overlaid with the industrial facilities (Column 2). Second, a buffer of 1 km radius was drawn around each facility (Column 3); for each buffer, a value of one was assigned to all the grids' centroid that lay within the search radius; the sum of the number of buffers that intersect each centroid was aggregated to each cell. Third, the number of facilities counted in each centroid was divided by the area of search of each facility, assigning a density value for each grid cell (Column 4). Finally, the census tracts were overlaid on top of the facility density grid, and then the average facility density value of all the grid cells falling within each CT was calculated and assigned as an attribute of that tract (Column 5). Industrial density was normalized by using the square root normalization procedure (Mennis and Jordan 2005). This procedure was used to estimate the density for C3 facilities and the combination of C2 and C3 facilities. (For the spatial distributions of the buffers according to each category see map 3.4 in Appendix 1.)

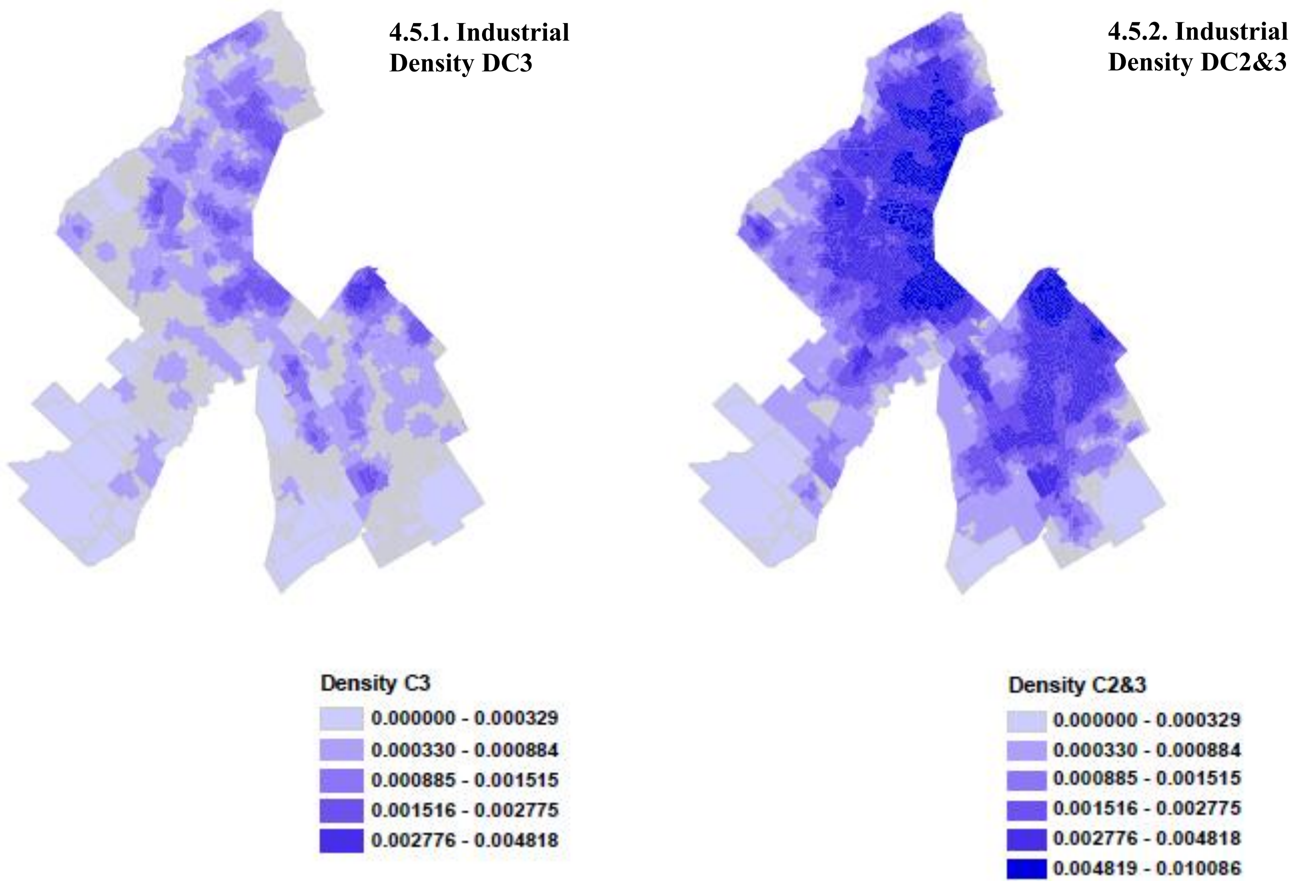
This estimation has the advantage of modeling the dependent variable as a continuous variable. Modeling density as a continuous fabric allows us to account for the different gradient effects of the facilities on the surroundings census tracts. Maps 4.5.1 and 4.5.2 show the distribution of densities for C3 and for C2 and C3 industries respectively. In both cases, higher industrial density concentrates around the borders of the City of Buenos Aires and decreases through to the periphery. However, there is an important difference in the degree of industrial density.[37] The results of the estimation procedure show important differences in intensity when considering C3 or the aggregated density C2&3 in terms of the highest and the average values. The average industrial density of C3 industries after normalization is 0.00063 and for C2 and C3 is 0.0026, and the highest value for C3 is 0.004818 while for C2&3 is 0.010086.

[37] It is important to notice that these categories represent different levels of risk for the population exposed to them and they could not be weighted accordantly with the data available.

Figure 4.1. Industrial Density Estimation

1- Grid	**2-Overlay: Facilities & Grid**	**3- Industrial Area of Influence**	**4-Density Grid**	**5-Industrial Density CT**
				
30mts Grid Resolution 1,150,855 grids	▲ Industrial Facilities	Search Area: R= 1Km	Density Grid= $\frac{\text{Aggregate \# of buffers}}{\text{Search Area}}$	Average Ind. Density CT = $\frac{\sum \text{density Grid (CT)}}{\text{\# of Grids (CT)}}$

Map 4.5. Industrial Density

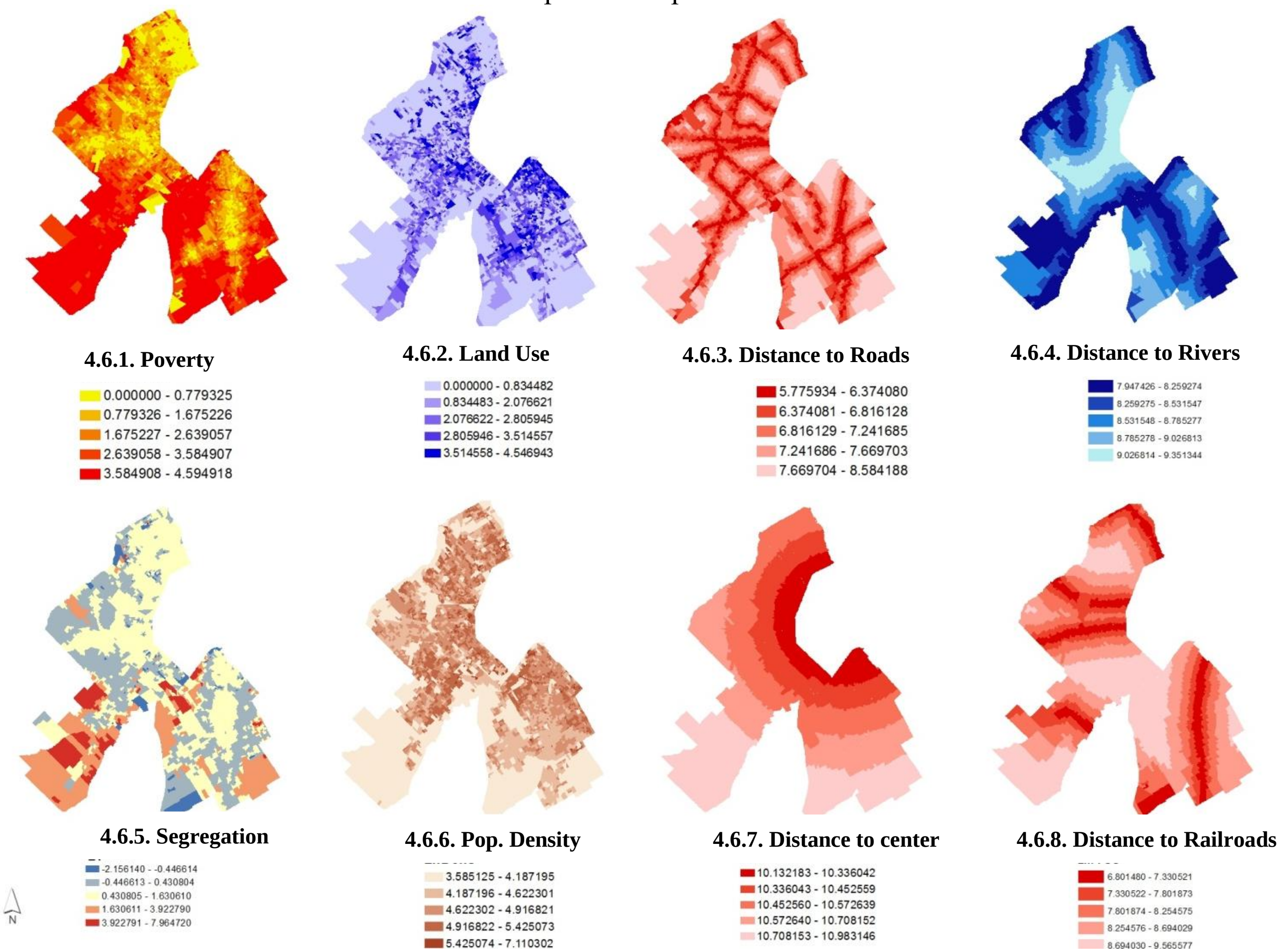


Industries are concentrated around the city of Buenos Aires. These industries create a 'buffer' surrounding the city with high levels of industrial density. As can be seen in map 4.5 this spatial distribution is similar when considering either one or two classes of industries, what varies is the density level in each case. In terms of the spatial distribution of poverty, the Map 4.6.1 shows that the highest concentrations of poor census tracts are located in the south and southwest parts of the AMBA following the Riachuelo River in the partidos of La Matanza, Lanús, Lomas de Zamora. Some pockets of poverty locate in the northern border of the study area along the Reconquista River. Segregated poor areas (Map 4.6.5), that is clusters of poor neighborhoods surrounded by poor neighborhoods are mainly concentrated along the Riachuelo River and to the western part of La Matanza. Conversely, segregated areas that show negative spatial autocorrelation, poor areas surrounded by middle class neighborhoods are dispersed in the Northern, Western and Southern parts of the study area.

The predominance of the central city in the metropolitan structure is clearly present in the spatial distribution of land uses, densities and infrastructure. The Industrial land uses (Map 4.6.2) are principally concentrated around the central city of Buenos Aires. Moreover as the maps 4.6.3 and 4.6.8 show communication infrastructures (i.e. roads and railroads) also converge to the central city. In the same manner, urban density (Map 4.6.6) decays following the transportation infrastructure towards the second ring. Finally, map 4.6.7 shows the variable that measures distance from the center of the city of Buenos Aires, this measure was taken from the centroid of the city of Buenos Aires.[38]

[38] No significant correlation among the independent variables was detected (see Table 4.2 correlation matrix in Appendix 2).

Map 4.6. Independent Variables



RESULTS OF THE MODELING

In this section the models results are presented in the following manner. The first part presents the univariate models results, while in the second section the multivariate results are discussed. In each case (i.e. univariate and multivariate models), global models are described and then compared with the performance of the local models. This comparison permits us to determine whether the local models represent and improvement over the global models. The objective is to test the hypothesis that the relationship between industrial density and the explanatory variables is not constant over the space. Finally, the GWR models results are explained through the output maps of each explanatory variable.

Univariate Models

In this section we will briefly present the result of the univariate models. The results of the global regressions for DC3 (Table 4.3) and DC2&3 (Table 4.4) univariate models show that the independent variables are all statistically significant in each univariate model. In the univariate models: poverty (DC3= -0.000075; DC2&3= -0.000522), and segregation (DC3= -0.000084; DC2&3= -0.000420) show a negative relationship with industrial density; meaning that the higher the industrial density the lower the percentage of poor neighborhoods and less segregated the areas. The same negative relationship holds for distance to center (DC3= -0.002481; DC2&3= -0.009638), that is the closer to the city the higher the industrial density. Conversely, the variables that capture the urban structure (i.e. urban density and accessibility) have a positive effect on industrial density. The only variable that it is not consistent between the models is distance to railroads which have a positive relationship with C3 industries, yet significant has a negative association with DC2&3 industrial density.

These global models present general trends in the data but do not capture spatial variation across the space. To investigate potential local differences across the area, univariate GWR models were conducted using the same OLS parameters. In table 4.3 the Akaike Information Criterion (AIC) values for the global models and the GWR models (AIC Local) are listed. Comparing the AIC values between the global (AIC) and local model, the AIC local are considerable higher than the AIC for the global models. This indicates that the GWR models represent a considerable improvement over the global models.[39]

The univariate local models show that there is variability in the relationship between industrial density and the independent variables. Although, these simple models include only one independent variable and are likely to be misspecified, they are useful exploratory tools to initially identify positive relationships and the explanatory value of each variable.

[39] Comparing two models, improvements in AIC that are less than 3 in value could be due to of sampling error, while values greater than 3 are more likely to be due a genuine difference between models (Fotheringham, Brunsdon et al. 2002).

Table 4.3. Global Univariate Models Results: Facilities Category 3

	Univariate Model 1 Facilities Category DC3							
Univariate Models	Estimate	SE	sig.	Adj. R2	F-test	sig.	AIC	AIC Local
Poverty	-0.000075	0.000007	***	0.020827	132	***	-55270	-60614
Segregation	-0.000084	0.000011	***	0.012579	82	***	-55231	-60709
% Industrial Land Use	0.000128	0.000007	***	0.074443	274	***	-55535	-60654
Distance to Roads	0.000253	0.000017	***	0.045251	124	***	-55389	-61315
Distance to Railroads	0.000104	0.000016	***	0.008547	62	***	-55212	-61107
Distance to Rivers	0.000332	0.000029	***	0.027074	122	***	-55300	-61010
Urban Density	0.000228	0.000027	***	0.014989	70	***	-55242	-60605
Distance to Center	-0.002481	0.000057	***	0.28628	1159	***	-56758	-60705

Probability of Rejecting H0: *** $p<0.01$; **$p<0.05$; *$p<0.1$

* Intercepts omitted

Table 4.4. Global Univariate Models Results: Facilities Categories 2 and 3

	Univariate Model 2 Facilities Category DC2&3							
Univariate Models	Estimate	SE	sig.	Adj. R2	F-test	sig	AIC	AIC Local
Poverty	-0.000522	0.0000204	***	0.1202	655	***	-46501	-54757
Segregation	-0.000420	0.000031	***	0.0377	188	***	-46072	-54715
% Industrial Land Use	0.000353	0.000019	***	0.0661	340	***	-46215	-54523
Distance to Roads	0.000321	0.000050	***	0.00543	41.4	***	-45928	-55203
Distance to Railroads	-0.000089	0.000046	*	0.0006	3.71	*	-45890	-55303
Distance to Rivers	0.002804	0.000074	***	0.2317	1446	***	-47151	-55183
Urban Density	0.000995	0.000074	***	0.0359	179	***	-46063	-54558
Distance to Center	-0.009638	0.000136	***	0.511127	5014	***	-49319	-54689

Probability of Rejecting H0: *** $p<0.01$; **$p<0.05$; *$p<0.1$

In Appendix 1, Maps 4.7 and 4.8 show the univariate models results and the R-squared values for each univariate model. The maps in the top row show the GWR coefficients output and only include the significant values. The color code indicates in red the positive and the blue the negative values. The maps in the bottom row show the GWR R-squared values for each model. The R-squared values are represented in a grayscale with the darker grays representing the highest value.

Unlike the OLS univariate models that show a negative relationship between industrial density and poverty, the local models show that there are some pockets of poverty that are significantly and positively associated to industrial density. This association shows similar patterns in both models (i.e. DC3 and DC2&3). The output maps show that these poor areas are especially located in the north and west areas at the border of the city of Buenos Aires and in the form of a wedge in the south (see Maps 4.7. and 4.9. in Appendix 1). In the same way, local models show that there are a few segregated areas that have a positive relationship with both types industrial density. These areas are relatively small and are mainly located toward the west and more distant from the city of Buenos Aires than the poor areas identified above.

Among the other univariate models, the percentage of industrial land has a positive relationship with industrial density mainly in the areas that surround the city of Buenos Aires. As expected, distance to the city center has mostly a negative association with both types of industrial density: that is the closer to the city the higher the industrial density. The univariate model that considers roads shows that roads have an important effect in industrial density especially in the northern and southern parts. The railroads also have important effects in all directions, north, west and south. Finally, rivers in general are associated with industrial density, specially the Riachuelo River in the south west (see Maps 4.7. to 4.10 in Appendix 1).

Multivariate Models

The OLS results for DC3 and DC2&3 multivariate models are shown in table 4.5. The global Model 1 DC3 has an R-squared value of 0.36 and all the variables included in the model are statistically significant. The results from Model 1 DC3 show that poverty has a positive relationship (0.000023), while segregation, on the contrary, has a negative relationship with industrial density (-0.000061). This seems to indicate that while there is a positive relationship between poverty and industrial density, poor segregated areas are not associated with industrial concentration. Higher densities of DC3 facilities are positively associated with the percentage of industrial land uses and accessibility (i.e. roads and railroads). Conversely, the effects of distance to rivers, urban density and distance to the city center on industrial density are negative: i.e. the higher the concentration of DC3 industries, the lower the urban density, and the closer to the rivers and to central city.

Table 4.5. Standardized Coefficients for Global Regression Multivariate Models

OLS	**Model 1 Facilities DC3**			**Model 2 Facilities DC2 and 3**		
Independent Variables	Estimate	SE	sig.	Estimate	SE	sig.
Intercept	0.025427	0.000895		0.075776	0.00203133	
Poverty	0.000023	0.000008	***	-0.000045	0.000023	**
Segregation	-0.000061	0.000009	***	-0.000154	0.000021	***
% Industrial Land Use	0.000087	0.000006	***	0.000194	0.000013	***
Distance to Roads	0.000178	0.000015	***	0.000199	0.000034	***
Distance to Railroads	0.000052	0.000015	***	-0.000034	0.000034	n/s
Distance to Rivers	-0.000048	0.000025	**	0.001459	0.000057	***
Urban Density	-0.000088	0.000024	***	-0.000286	0.000054	***
Distance to Center	-0.002460	0.000071	***	-0.008182	0.000162	***
Adjusted R-square		0.365			0.608	
F-test		255	***		772	***
AIC		-57291.7761			-50381	
GWR Model						
Adjusted R-square		0.835346			0.933253	
AIC		-63277.5389			-58479.29	
Bandwidth		242			246	

Probability of Rejecting H0: *** p<0.01; **p<0.05; *p<0.1

The OLS Model 2 DC2&3 has a better performance compared to Model 1 DC3. This global has an R-squared value of 0.6. In this model most of the independent variables are statistically significant with the exception of distance to railroads which has a non significant effect on industrial density. In contrast to Model 1 DC3 results, poverty shows a negative and significant relationship (-0.000045) with the concentration of industrial facilities DC2&3. In the case of segregation, the results are consistent with the previous model. Segregation has a negative and statistically significant (-0.000048) relationship, and in the same manner industrial density and distance to the center have negative effects on industrial density. Finally, industrial density is positive associated with the percentage of industrial land uses, and distance to roads and rivers.

In order to test the hypothesis of local variation between industrial density and explanatory factors across the 12 partidos in the AMBA, GWR models were conducted using the same OLS independent variables. Comparing the global and the local models, the GWR model represents an improvement over the OLS models. To evaluate the performance of the GWR respect to the OLS the AICs provided in the regression output are compared; recall that a difference of more than three points shows an improvement over the global model. Table 4.5 shows that in Model 1 DC3 (AIC = -63277.5389) and Model 2 DC2&3 (AIC = -58479.29), the reduction in the AIC from the global (AIC = -57291.7761 and AIC = -50381) model suggests that the local models are better even accounting for the differences in the degrees of freedom. Moreover, the ANOVA test also rejects the null hypothesis that the GWR represent no improvement over the global model in both cases (see Table 4.6 in Appendix 2).

Maps 4.11 and 4.12 in Appendix 1 show the predicted values, the local R-squared and the residuals distribution for Model 1 DC3 and Model 2 DC2&3 respectively. The map of predicted values of the local estimates for both models show similar spatial patterns. Higher industrial densities are mainly located in the surroundings of the city of Buenos Aires decreasing towards the periphery. These areas coincide with the highest R-squared values. The spatial distribution of the residuals in the maps show that residuals are distributed in the whole study area showing and there are no significant positive cluster patterns, with only a few exceptions such as in the south (see that the partido of Lanús where the red color identifies the positive residuals' clusters).

To test for spatial variability in the relationship between industrial density and explanatory factors we employed the Monte Carlo test. Table 4.7 shows the significance of spatial variability in the local parameters estimate for both models. The test indicates that there is significant spatial variation in the local parameters estimated for poverty and segregation as well as for the distance variables (i.e., in both models, P-value $\leq$ 0.01). However, percentage of industrial land use presents non-significant spatial variability (P-value = 0.12 in DC3 and P-value = 0.57 in DC2&3), meaning that the spatial variation of this variable may have occurred by chance or due to sampling variation. In the case of urban density the test's results indicates that while spatial variability is significant in relation to DC3 (P-value $\leq$ 0.01), it is non-significant in relation to DC2&3 (P-value = 0.96).

This indicates that, among other explanatory factors, the global models do not fully capture the relationship between industrial density and poverty and segregation. This is especially important because it means that the relationship between industrial concentration and poverty and segregation is not constant over the space, and it is possible to identify pockets of poverty and segregation that have an effect on the concentration of polluting industries.

Table 4.7. Monte Carlo Test for spatial variability of the parameters

	GWR Model 1 Facilities DC3		**GWR Model 2 Facilities DC2 and 3**	
Parameter	P-value	Sig	P-value	Sig
Intercept	0.0000	***	0.0000	***
Segregation	0.0000	***	0.0000	***
Poverty	0.0000	***	0.0000	***
% Industrial Land Use	0.1200	n/s	0.5700	n/s
Distance to Roads	0.0000	***	0.0000	***
Distance to Railroads	0.0000	***	0.0000	***
Distance to Rivers	0.0000	***	0.0000	***
Segregation	0.0000	***	0.0000	***
Urban Density	0.0000	***	0.9600	n/s
Distance to Center	0.0000	***	0.0000	***

Probability of Rejecting H0: *** $p<0.01$; ** $p<0.05$; * $p<0.1$

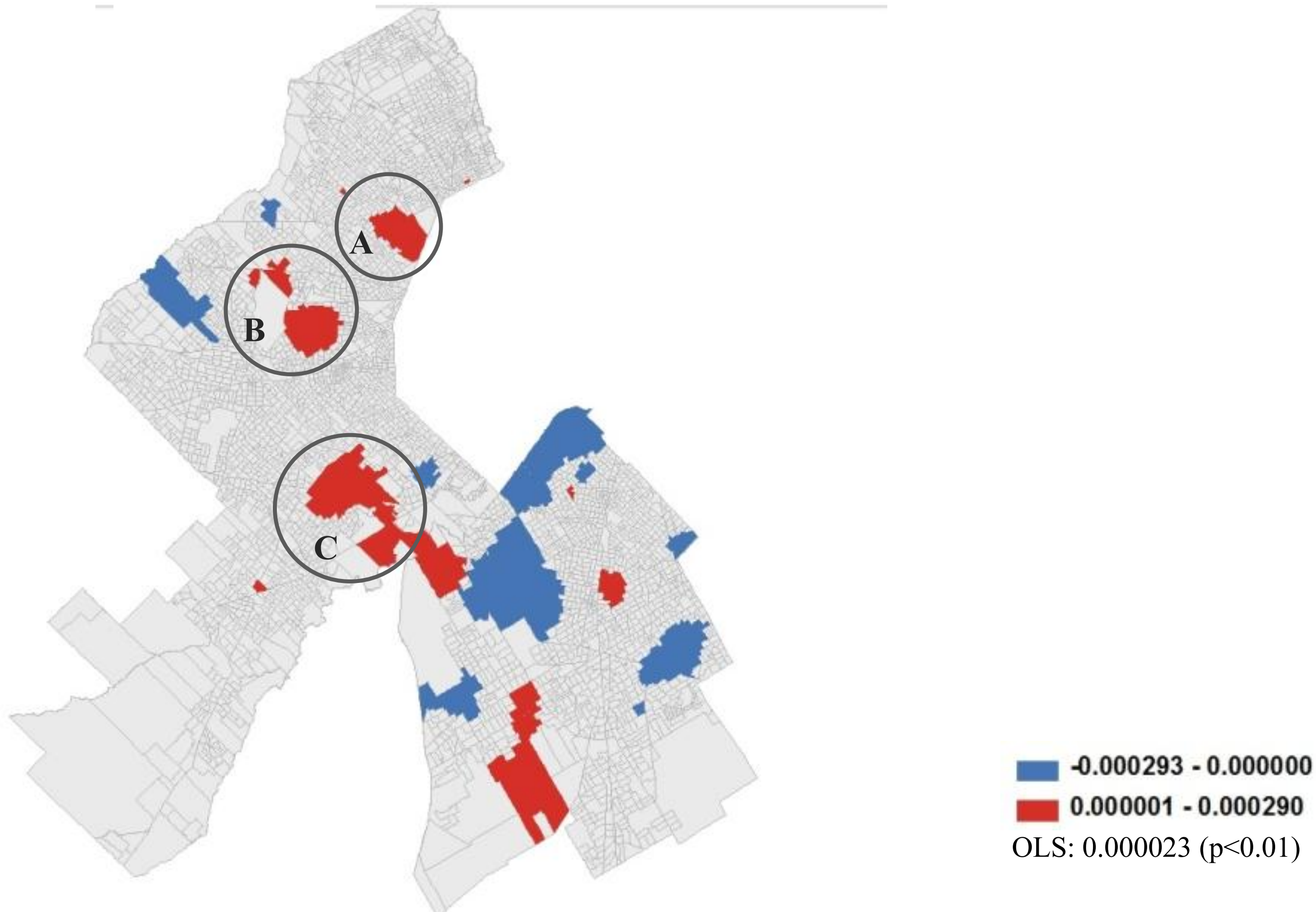
The results of the local models show that there are variations in the relationship between industrial density and explanatory factors. Both local models show that some poor areas are positively and significantly associated with industrial density (Maps 4.13 and 4.14). These results show similar patterns with slightly differences in terms of the extent and location of these areas. The areas in color identify the statistically significant associations: red areas identify positive, and the blue areas the negative associations. While the global model identified a significant and positive association between DC3 and poverty (0.000023), Map 4.13 shows the results of the local model in which some poor areas positively associated with the industrial density of hazardous industries Category 3 (Model 1 DC3). These areas are located to the west and the southern parts of the first ring in the partidos of San Martín, Morón La Matanza, Esteban Echeverría (West) and Lomas de Zamora (South). These pockets of poverty do not locate at the border of the central city with the exception of San Martín. Most of them are located at an average distance of

17 km from the centroid of the city of Buenos Aires. Furthermore, these poor areas do not necessarily coincide with the highest concentration of DC3 facilities.

In contrast with the results of the OLS Model DC2&3, which indicate a negative significant association between poverty and industrial density (-.000045), local Model 2 DC2&3 indicates that there is a higher correlation between poverty and industrial density when considering industrial categories 2 and 3. Map 4.14 shows that poor areas positively associated with the industrial density cover larger areas than those estimated in the previous model. Furthermore, map 4.14 indicates that these poor areas tend to locate mainly in the west. These pockets of poverty are located in the partidos of Vicente López, San Martín, Morón, Tres de Febrero, La Matanza and Esteban Echeverría. Moreover, these areas locate closer to the city, at an average distance of 12 km from the centroid of the city of Buenos Aires, than those identified in the DC3 model. Most of these pockets seem not to coincide with the highest values of industrial density of DC2&3.

To explore the association between poverty and industrial density, census tracts that are positively associated to industrial density are analyzed. Below we examined in more detail the characteristics of the areas in terms of the level of industrial density and poverty. The census tracts corresponding to positive and significant values are identified in maps 4.13 and 4.14 with the letters A, B and C for those located in the partidos of San Martín, Tres de Febrero and La Matanza respectively. Tables 4.8.1 and 4.8.2 provide a description of these census tracts in terms of population characteristics and industrial density compared to each partido average values for Model 1 DC3 and Model 2 DC2&3 respectively.

Map 4.13. Multivariate Model1 DC3- Poverty:
Statistically Significant Areas.



Map 4.14. Multivariate Model2 DC2&3: Poverty:
Statistically Significant Areas.

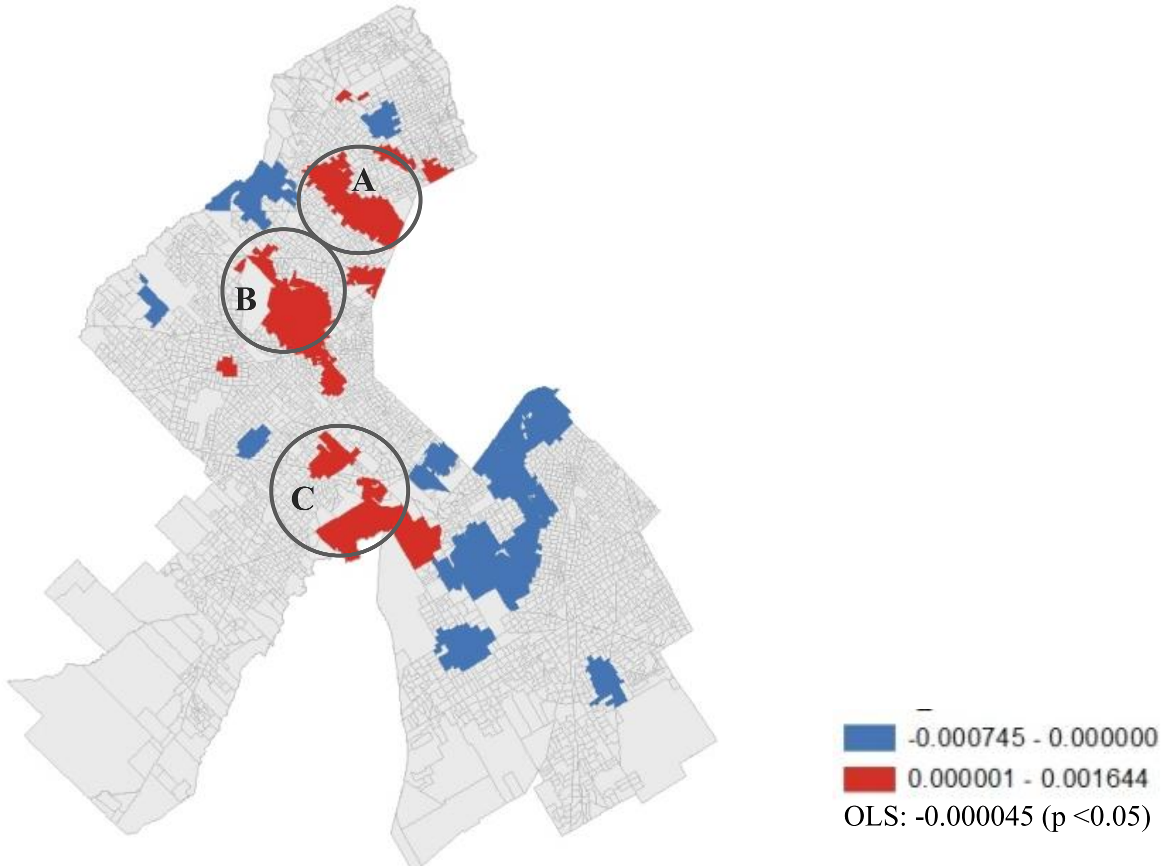


Table 4.8.1. Characteristics of the Census Tracts with significant positive association between industrial density and poverty. Model 1. DC3

	# of CT	**Total # CT**	**% of CT exposed**	**% Poverty***	**% Poverty***	**Industrial Density***	**Industrial Density***
Partido	Exposed	Partido	Partido	Area	Partido	Area	Partido
San Martín (A)	42	387	10.85	5.7	11.27	0.000934	0.000930
Tres de Febrero (B)	61	344	17.73	6.57	6.45	0.000927	0.000909
La Matanza (C)	94	1096	8.58	20.7	26	0.000629	0.000574

Average Industrial density C3 in the 12 partidos 0.00063

Table 4.8.2. Characteristics of the Census Tracts with significant positive association between industrial density and poverty. Model 2. DC2&3

	# of CT	**Total # CT**	**% of CT exposed**	**% Poverty***	**% Poverty***	**Industrial Density***	**Industrial Density***
Partido	Exposed	Partido	Partido	Area	Partido	Area	Partido
San Martín (A)	122	387	31.52	3.72	11.27	0.004596	0.004500
Tres de Febrero (B)	86	344	25.00	3.877	6.45	0.004883	0.004380
La Matanza (C)	95	1096	8.67	10.54	26	0.002742	0.002362

Average Industrial density C2 and 3 in the 12 partidos 0.0026

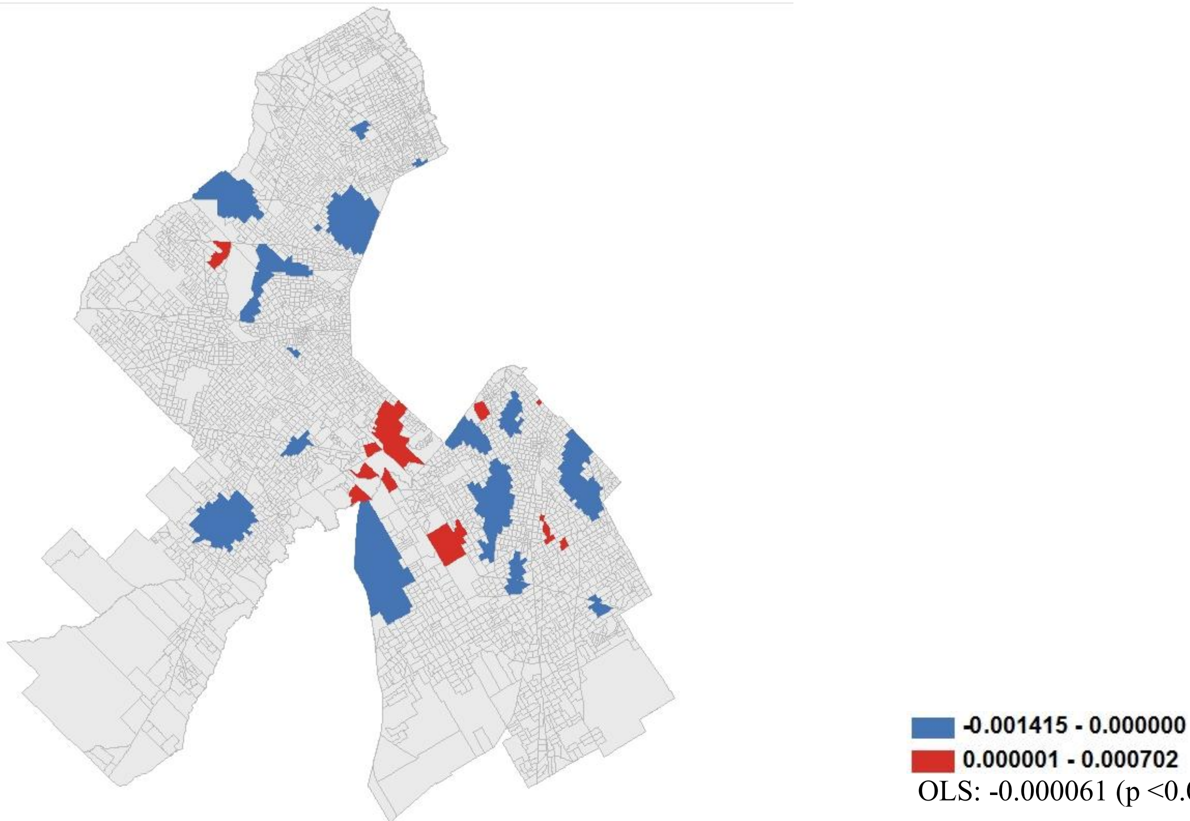
(*) Mean values
CT: census tracts
The letters A, B and C identify the census tracts in map 4.14.

The census tracts corresponding to positive and significant values are located in the north and western parts of the first ring; these partidos are San Martín, Tres de Febrero y La Matanza. Table 4.8.1 describes the characteristics of the tracts regarding Model 1 DC3. San Martín is the partido with highest level of industrial density (DC3) compared to the other two. However, only 10 percent of the census tracts in the partido show a positive association between poverty and industrial density. An interesting characteristic of those tracts is that the percent of poverty present in them (5.7%) is below the partido's average (11.27), while industrial density is around the partido's average. In the case of Tres de Febrero has the highest percentage of poor tracts exposed to high levels of industrial density compared with the other two cases. The positive associated poor tracts have the partido's average percentage of poor and the average percentage of industrial concentration compares with the partido. Finally, La Matanza is one of the biggest and the poorest partidos in the AMBA, but only 8.67 percent of the census tracts are positively associated with polluting industries. The level of poverty (20.7%) in those census tracts is below the partidos average (26%), but is the highest compared with San Martín and Tres de Febrero. These tracts show a slightly higher level of industrial density (0.000629) compared to La Matanza's average (0.000574), but equal the average levels of industrial density of the study area (0.00063). In conclusion, these results suggest that in the cases in which there is a positive association between poverty and concentration of DC3 industries, the levels of exposure are similar to the average industrial density of each of the partidos but compared with the average of the whole study area, these census tracts show higher levels of exposure to stationary sources of environmental pollution.

Table 4.8.2 shows the positive association between poverty and industrial density DC2&3. San Martín (A) is the partido with the highest DC2&3 (0.004596) and with the highest percentage of tracts that present a positive association between poverty and industrial density (31.52%). An interesting characteristic of those tracts is that the percentage of poverty in them is 2/3 less than the partido's average, while industrial density (0.004596) is higher than the partido average (0.0045). San Martín has the highest number of poor census tracts exposed to DC2&3 compared with the other two cases. In the case of Tres de Febrero (B), the percentage of poverty (3.87) in exposed census tracts is below the partido's average (6.45). Regarding DC2&3 the exposed tracts have a higher industrial density (0.00488) than the partido's average (0.00438). Finally, La Matanza (C) has the lowest percentage of tracts with poverty levels significantly associated to industrial density DC2&3 (8.67%) compared with the San Martín and Tres de Febrero, but those tracts have an industrial density of 0.002742 that is higher than the average for La Matanza (0.002362). In the case of Model 2 DC2&3 the tracts in which the results show a positive association between poverty and concentration of industries, the percentage of poor exposed to these facilities are below the average poverty level present in each of the three partidos. Regarding the level of industrial density, as the results from Model 1 indicate, San Martín and Tres de Febrero have an industrial density above the study area's average, while in Model 2 the three have an industrial concentration above the mean of the whole study area.

In terms of segregation, the results from the global models differ from the local models. While the global models indicate that there is a negative association between segregation and both industrial densities (DC3: -0.000061; and DC2&3: -0.000154) the local models identify some segregated areas positively and significantly associated with industrial density (Maps 4.15 and 4.16). Map 4.15 shows that few poor segregated areas are positively associated with industrial density DC3. These segregated areas are located towards the southwest, mainly in the partidos of La Matanza, Lomas de Zamora. Some small pockets are also detected in Lanús and Morón. Regarding DC2&3 segregation patterns are similar to those observed in model DC3, but as Map 4.16 shows there are a couple of newly segregated pockets in the west (Morón), and a slightly reduction in size of those previously identified in the south. In both cases these areas coincide with moderated levels of segregation.

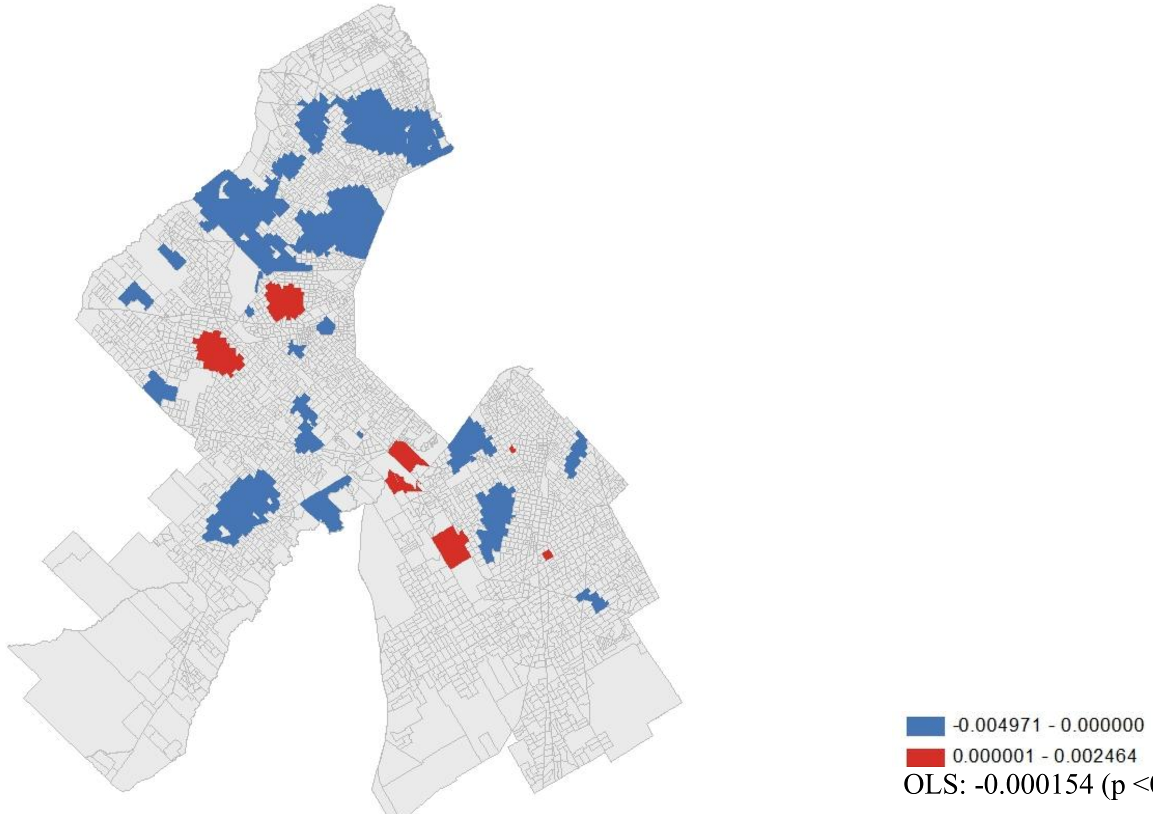
Map 4.15. Multivariate Model2 DC3: Segregation: Statistically Significant Areas.



OLS: -0.000061 (p <0.01)

Map 4.16. Multivariate Model2 DC2&3: Segregation:

Statistically Significant Areas.



OLS: -0.000154 (p <0.01)

Regarding the other explanatory variables (i.e. the control variables: percentage of industrial land-use, distance to: roads, railroads, rivers, center, and urban density), the results are consistent with the local univariate model results. However, in the multivariate models, when controlling for other factors the extent of the positive associated areas to industrial density decreases considerable in both cases. Maps 4.17 and 4.18 in Appendix 1 show the statistically significant values for each independent variable, these maps refer to Model 1 DC3 and to Model 2 DC2&3 respectively. As in the previous output maps, the areas in color identify the statistically significant associations: red areas identify positive, and the blue areas the negative associations.

All the control variables present significant spatial variations across the 12 partidos. When comparing Model DC3 and DC2&3 these variables show similar spatial pattern with slightly variations in terms of the areal extend. For instance distance to roads has an important effect on both types of industrial density mainly in areas located near the central city and in the north and the south (see Maps 4.17.1 and 4.18.1 in the Appendix). These areas coincide with the highest levels of industrial density in both models. Cargo railroads are more associated to the industrial concentration to the west and the south (see Maps 4.17.2 and 4.18.2). Furthermore, railroads seem to have a broader spatial effect on industrial density reaching more distant locations from the central city, these areas coincide with lower levels of industrial concentration. These associations were expected given the historical relevance that both types of infrastructure played in the industrial development of the AMBA. Another important variable that significantly explains the distribution of industrial density are the rivers. Rivers in general also have important effects on both types of industrial density; the Riachuelo in the south, the Resistencia in the west and the La Plata river on the north (see Maps 4.17.3 and

4.18.3). Urban density has very small and localized effects that differ between models (Maps 4.17.4 and 4.18.4). Even though the output for the percentage of industrial land shows some localized effects on industrial density this relationship is stationary, consequently there is no significant variation of the relationship across the space. These results illustrate that several factors account for the distribution of polluting facilities, and the weight they have vary spatially over the 12 partidos analyzed.

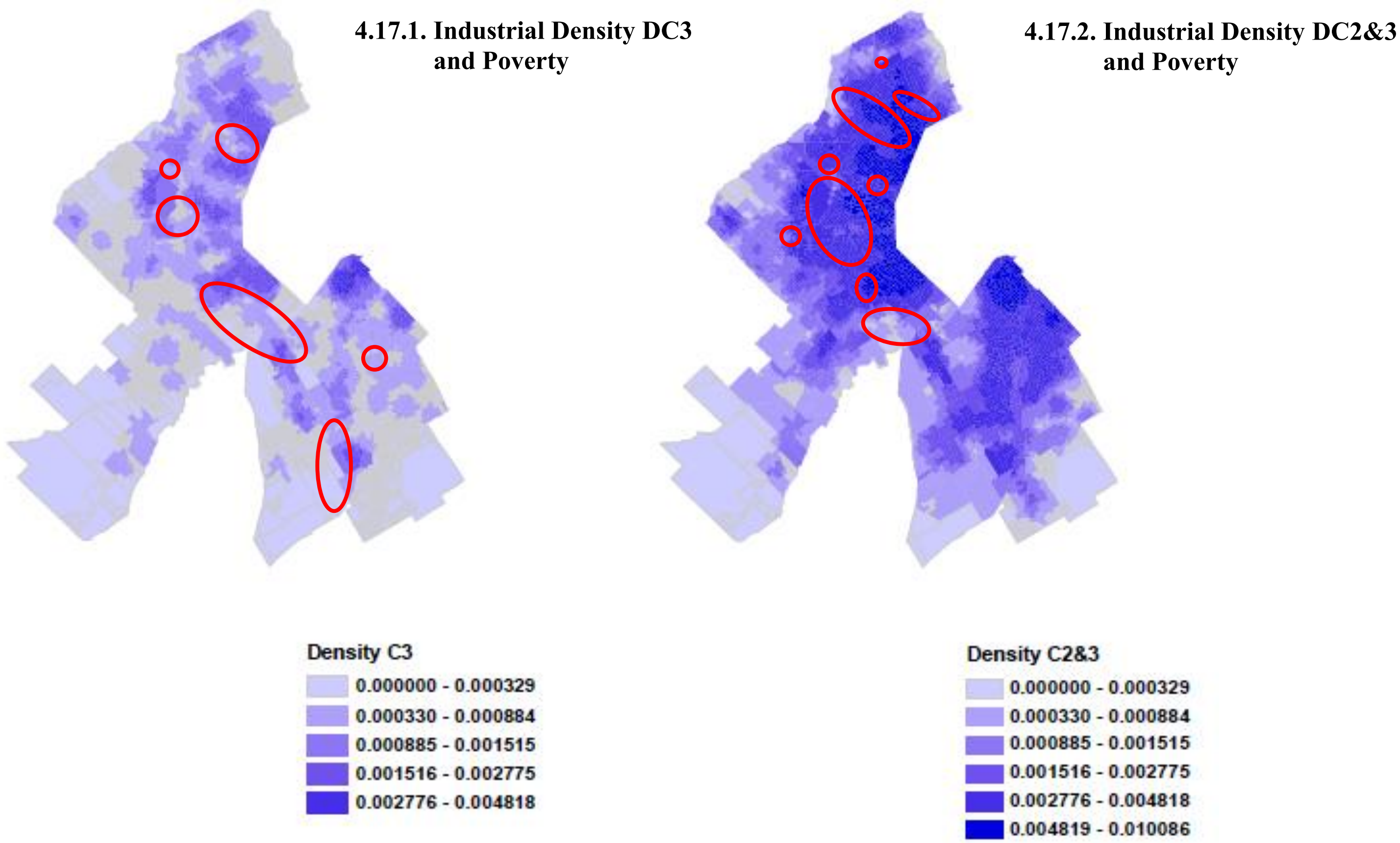
DISCUSSION:

The global models discussed in this chapter indicate that while the concentration of hazardous facilities (Category 3) is positively correlated to poverty, the concentration of all polluting facilities (Categories 2 and 3) is, on the contrary, negatively correlated to poverty. These models assume that the relationship between dependent and predictor variables is spatially stationary showing an average relationship across the study area. However, this study shows that the relationship between industrial density and poverty is not homogenous over space when the stationarity hypothesis is tested against the local models. Indeed, the GWR output maps show that the effects of poverty and segregation on industrial density vary across the study area. In this manner, the local models reveal the limitations of the global models in capturing this spatial phenomenon and further identify specific areas where the association holds.

Moreover, local models show that the spatial effect of poverty on industrial density varies when considering hazardous facilities alone (DC3) or when combined with other polluting industries (DC2&3). The corresponding synthesis maps (Map 4.17.1 for Model DC3 and Map 4.17.2 for Model DC2&3) show circled in red the poor areas discussed in the previous section that have a positive effect on industrial density. The results indicate that when considering hazardous industries (Category 3) exclusively only some poor areas have an effect on industrial density; but when considering the aggregate effect of polluting industries (Categories 2 and 3) more poor areas seem positively associated with industrial density. In the same way, differences exist regarding the spatial distribution of these poor areas; those areas associated with DC3 are more distant from the city of Buenos Aires than those associated with DC2&3.

Both cases of industrial density (Models DC3 and DC2&3) show that most of these poor areas have an industrial concentration considerably above the study area's average value and above each partido's average. However, these areas do not coincide with the highest levels of industrial concentration; instead, the maps indicate that the poor locate in the interstices between the areas with the highest levels of both types of industrial density. Moreover, the models indicate that the percentage of poor in the census tracts with a statistically significant and positive relationship to industrial density is below each partido's average. This implies that these poor areas do not have the highest concentration of poor population. It is worth noting that the local models indicate differences in the level of poor exposure to polluting facilities; according to the results, the poor are more exposed to DC3 than DC2&3 facilities, but these poor areas do not coincide with the highest levels of industrial density in both cases. In sum, the results show that when poor neighborhoods are exposed to important levels of industrial density they contain neither the higher density of poverty nor the highest levels of industrial concentration.

Map 4.17. Synthesis Map: Spatial Outcomes, Industrial Densities and Poverty.



In the analysis of segregation, the results of the global model show that segregation has a negative effect on industrial concentration for both types of industrial densities. The GWR models show that very few segregated areas are positively associated to industrial density. These findings seem to indicate that industrial pollution in general is distributed across all social sectors as they show that non-segregated census tracts are also affected by industrial environmental outcomes. As Kreig and Faber (2004) argue, mixed socio-economic areas are not typically identified (compared to poor neighborhoods) as facing significantly important environmental threats. The results from the local models for segregation highlight, however, the need to widen the scope of the analysis of environmental pollution to include other socio-economic sectors of the population and not just the poor.

The explanation of these results can be understood by the historical process of urban growth in the AMBA. An early industrialization-urbanization process was carried out in close linkage with the development of industrial areas and the urbanization of working-class neighborhoods that formed around these areas. While the majority of the urban poor located mainly on the outskirts of the metropolis, those that resided in the first ring settled there through an in-fill process, occupying vacant land. This helps to explain why the identified poor and segregated areas do not coincide either with high levels of poverty nor with the highest levels of industrial density.

Finally, it is important to notice the methodological limitations of the studies that address the relationship between poverty and pollution and of this study in particular. As already discussed, it is possible that the Modifiable Areal Unit Problem directly affects the results. It is likely that at the scale of block group this result might capture in a different manner the relationship between poverty and industrial density. Probably, this could be a result of the urbanization process of the poor occupied relatively small- and middle-sized lots in the first, and the census-tract scale does capture such association. It is interesting to note also, that areas that are traditionally poor located in the south in close proximity to the CABA show a negative relationship with industrial density. This could be a consequence of the delimitation of the spatial extent of the study which may also influence the results. The extent of the spatial area it is important because it affects the definition of spatial continuity and the scope and direction of the bandwidth. Even though the bandwidth weights the observations according to proximity, the spatial extent poses important limitations on it. This could be the case in border areas where there is spatial continuity with the CABA or other partidos, but these neighboring areas are not included in the model. Under this restriction, the bandwidth is limited to consider only neighbors in one direction, and consequently the effects of other areas in close proximity are not considered in the local estimates.

The results presented in this chapter demonstrate that the relationship between poverty and industrial concentration needs to be tested under the space-based approach to explore the spatial variation of this relationship. Furthermore, it is necessary to consider if this relationship can be generalized to other Latin American cities or whether it is more specific to the case of the Metropolitan Area of Buenos Aires.

CHAPTER 5

TRACING THE SPATIAL DISTRIBUTION OF ENVIRONMENTAL OUTCOMES

The main objective of this chapter is to understand how socio-economic, institutional and market factors shape the distribution of environmental outcomes and mediate the relationship between sources of environmental pollution and residents living in nearby areas. This study is a systematic attempt to comprehend causality and policy outcomes as a complex process. The analysis seeks to understand and explain the causes of continuity and change in the spatial distribution of environmental outcomes over time.[40] The case studies trace the trajectory of two neighborhoods with dissimilar outcomes. Both cases present a high concentration of polluting industries with population of different socio-economic status.[41]

The first part of this chapter describes the case studies historical process of industrialization and urbanization of the selected case studies and the mechanisms of exposure. The second part analyzes the causal path that led to different outcomes, as well as the reasons of continuity and change in each neighborhood's trajectories.[42] Finally, it discusses in comparative a manner the implications of the findings in terms of policy and equity.

---

40 Spatial outcomes are considered as a result of a complex interaction between socio-economic and political systems.

41 The first case study, Munro in Vicente López, is a middle class neighborhood while the second one, Barracas al Sur in Lanús, is an extremely poor neighborhood.

42 This analysis follows the methodology presented in Chapter 2 (See Figure 2.1 Tracing the causal path).

TWO HISTORIES OF INTENSE INDUSTRIALIZATION:

BACKGROUND OF BOTH PARTIDOS

Munro - Partido of Vicente López

Vicente López is situated on the north of the city of Buenos Aires (CABA). As the other partidos of the north part of the AMBA, Vicente López concentrates upper and middle class neighborhoods. In spatial terms the partido has two distinctive areas: the north and the south. The areas located on the east, along the La Plata River shore, have been mainly residential areas of the upper class since the XIX century given their good environmental conditions and proximity to the central city. Conversely, the western part of the partido concentrates middle and working class neighborhoods since the early XX century associated with the industrial development of the partido.

These two areas share the characteristics of the surrounding partidos, while the east follows the higher economic standing and service sector orientation that are present in the city of Buenos Aires and San Isidro, the industrial characteristics of the west are reinforced by its proximity to San Martín and the industrial agglomerate of the west of the AMBA.[43] Given these contrasting socio-economic and spatial differences of Vicente López, this study will examine the industrialization and urbanization trajectory of the neighborhood of Munro.

---

[43] San Martín is one of the most industrial partidos in the AMBA and its known as the "Capital of the Industry" http://www.taringa.net/posts/info/915169/Partido-de-Gral_-San-Martín-_Mi-partido_.html

The area of Munro is located in the west of Vicente López at the limit with San Martín. The industrialization of Munro coincides with the rapid industrialization experienced by Argentina during 1930 – 1950 as consequence of the import substitution model (Mosquera and Calderón 1995).[44] A diverse number of industries, including textiles, chemical and metal engineering industries settled in the area. During the 1990s the de-industrialization process of the AMBA and the economic crisis strongly affected the industrial sectors located in Munro,[45,46] and even though some important industries remained in the area the overall number has declined significantly.[47]

The development of Munro is related to the extension of the Ferrocarril Córdoba Central in 1912, and the railroad line the first industries started to settle in the area. At the same time, the railway company, in association with the Compañía Argentina de Tierras del Norte, acquired land near the railway and subdivided the land for urbanization (Irabelli 1997) starting in 1922 around the railroad station.

By the middle of the 1930s a rapid process of industrialization of the area began characterized by diverse types of industrial sectors that included textiles, chemicals, and metal-mechanical industries.[48] The rapid industrialization of the area was followed by the

---

[44] During this period the industrial sectors that experience the highest growth were the textile and the metal-mechanical industry.

[45] There is no information about the numbers of industries in Vicente López.

[46] Interview Arch. Ceppi. Planeamiento Urbano, Municipalidad de Vicente López (2009).

[47] Interview Ing. Foscaldo, Seguridad e Higiene Municipalidad de Vicente López (2009)

[48] Some of the industries were Atanor, Fabriloza, Colorín, Virulana, Ripán, Telagoma, Bayer, Gillette, Coghlan, Sedalana, Laboratorios Lazar, Kurlat, etc.

urbanization of working and middle-class neighborhoods near to the industrial facilities, and was undertaken by private developers who provided housing for the new population seeking employment opportunities in the industrial sector located in Munro.[49] In this case it is clear that the development of the area started mainly with the location of important industrial firms and that the subsequent urbanization of working class was a consequence of that process.[50]

The historical analysis that I undertook of the aerial photographs shows that by 1967 the area was consolidated with mixed industrial and residential uses.[51] Maps 5.1 and 5.2 show the neighborhood evolution from 1967 to 2008, with the residential areas marked in gray color and industrial facilities and storehouses identified in purple. As the images and Table 5.1 show, residential areas were mostly consolidated by 1967 occupying 59.1 ha. In 1992 this increased slightly by 4.8 percent and remains stable to the present.

The area is characterized by a strong industrial presence with some big size facilities, like Atanor, and several middle and small-sized industries.[52] Throughout the period there is an increasing trend of industry establishment from 1967 to 1992, during

---

[49] In 1938 there was an important increased in the population that rises from 5,000 in 1905 to 70,000 in 1938.

[50] Interview Arch. Ceppi (2009). Planeamiento Urbano, Municipalidad de Vicente López.

[51] The aerial-photos cover the area located between the streets Gobernador Ugarte, Gral Belgrano, Francisco Borges and Fray Mamerto Esquiú.

[52] Atanor covers 20 percent of the total industrial area. This industry is identified with the letter A in the Maps 5.1 and 5.2.

which industrial areas increased by 24 percent. However, from 1996 to 2008 industrial facilities decreased slightly by 8.3 percent compared to 1992 (see Table 5.1),[53] representing a small reduction of the industrial area. These maps also show a subtle industrial tendency to consolidate in the south-west and north-east area and a tendency to abandon predominantly residential areas. The number of blocks with mixed land uses goes from 69 percent in 1967 to 62 percent in 2008.[54] Furthermore, it is important to consider that in addition to the reduction in the size of industries, some industries that still remain in the area have relocated sections of its most polluting activities outside Munro.[55] This has reduced the environmental burdens in the neighborhood.

---

[53] It is important to mention that industrial facilities and storehouses are considered as industrial uses in the photo-interpretation.

[54] This percentage includes the total number of blocks that combines industrial and residential land uses together.

[55] Interview Ms. Mora Arauz (2009) Fundación Ciudad.

Table 5.1. Munro (1967-2008)

Land use change

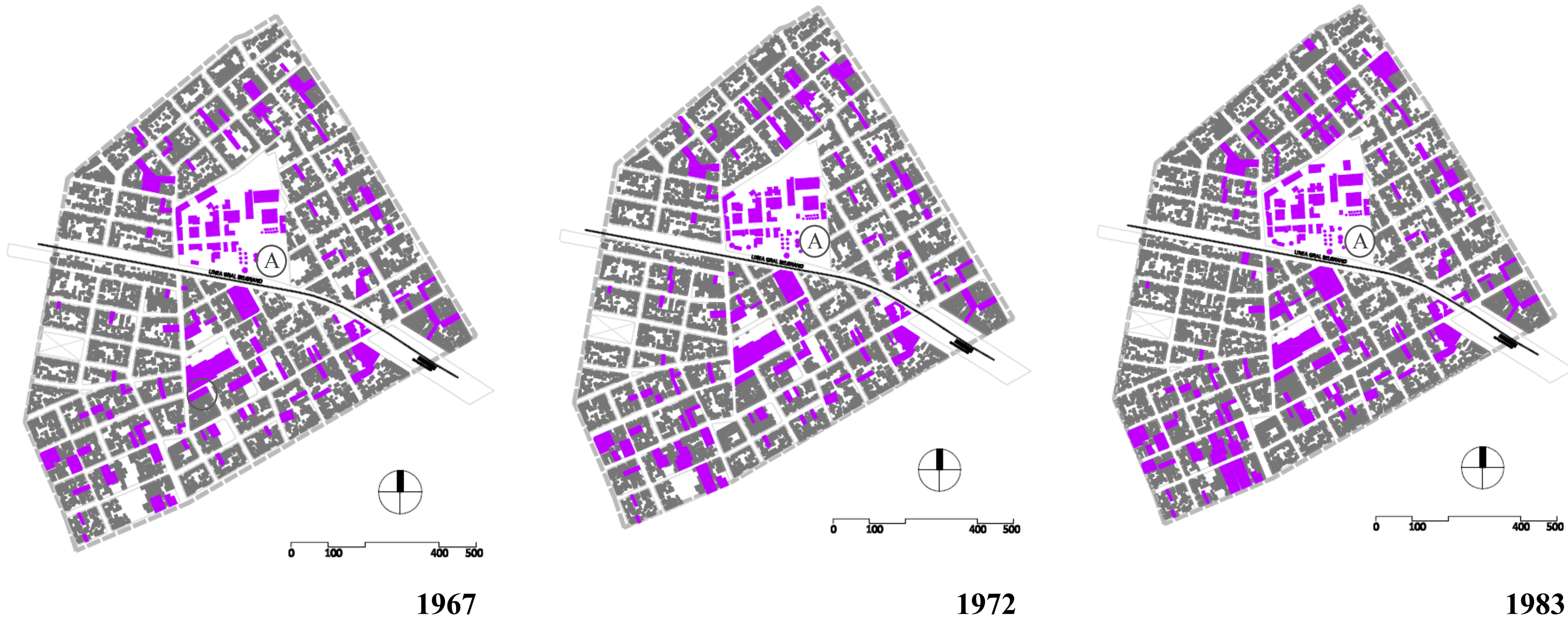
Year	Total residencial land uses (ha)	% of change Residential Land Use	Residential Land Use Change	Total Industrial land uses (ha)	% of change Industrial Land Use	Industrial Land Use Change
1967	59.1			9.64		
1972	60.2	102	1.9	10.23	106	6.1
1983	60.4	100	0.3	11.83	116	15.6
1992	63.3	105	4.8	11.98	101	1.3
1996	63.5	100	0.3	11.97	100	-0.1
2008	63.6	100	0.2	10.99	92	-8.2
Total % of change			**7.5**			**14.8**

Source: Author's compilation based on the interpretation of aerial photograph.

* Total area 104 hectare
**Land Uses Areas do not include open spaces and streets areas.
***The facilities areas are base on the photo-interpretation of aerial photographs for each year. All facilities detected are included in the estimation and it is likely that some of them may not be operating at the time the picture was taken.

Map 5.1. Munro – Industrial Land Use Change

Period 1967-1983



References:

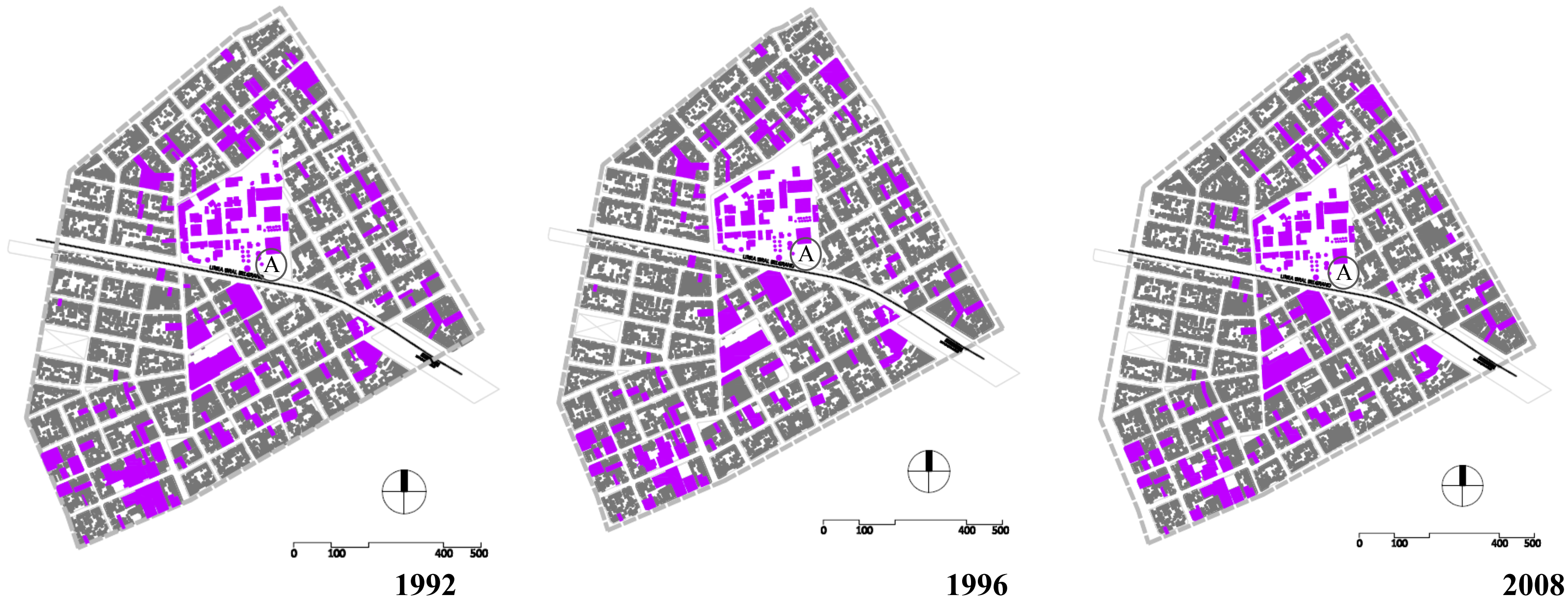
Industries and storehouses

Consolidated residential areas

Source: Author’s compilation based on the interpretation of aerial photograph.

Map 5.2. Munro – Industrial Land Use Change

Period 1992-2008



References:

Industries and storehouses

Consolidated residential areas

Source: Author’s compilation based on the interpretation of aerial photograph.

Throughout this period the spatial distribution of industrial land uses in Vicente López was limited by zoning ordinances. In 1923, the Comisión de Establecimientos Industriales (Committee of Industrial Facilities) was created, and by 1934 industrial uses were designated on the west and north part of Vicente López on the boundary with San Martín and part of San Isidro, and these same industrial areas were increased in 1936 (Graso 1953). This encouraged the concentration of industrial facilities in the area of Munro. Nevertheless, there was no specific regulation regarding residential land uses, and as a consequence, mixed land uses are a feature of the area since early times. In the following years zoning regulations were limited. During the military regime (1976-1983), some specific industrial areas, like Atanor, were classified as reserves to restrict industrial growth, and provided only for the improvement of existing facilities. In 1992, the municipality proposed to create two areas: one exclusively industrial, and the other with a mix of industrial and residential areas. Facing the industrial chamber's opposition to the changes and the limitations that this new zoning posed to the existing industrial areas and future developments, that proposal failed to prosper. Consequently, the zoning ordinance of 1992 basically recognized existing conditions, and under this regulation most of the industrial areas allowed mixed uses, with only a very small proportion designated as exclusively industrial.[56]

As the adverse effects of the economy began to directly impact the industrial trajectory of Munro, the local government started to delineate alternative economic scenarios. In this context planning ordinances sought to provide incentives to locate other activities that would shift the trajectory from industrial to service activities. The municipality created incentives to reconvert industrial areas into service and residential

[56] Interview Arch. Ceppi, Planeamiento Urbano, Municipalidad de Vicente López.

developments by allowing increases in the buildings' constructed area subject to the lot's characteristics.[57] However, despite the incentives these changes only started to occur in areas in the interface between the northern and southern parts of Vicente López along the Panamericana Highway.[58] Beside the local government intervention, this change was framed in a general process of decentralization and expansion of services into the north corridor of the AMBA that started during the '90s (Vecslir and Ciccolella 2011).[59]

The Environmental Agenda, Collective Action and the Judiciary: The Cases of ATANOR and DIACROM

As mentioned above, the '90s marked a turning point in relation to the economy and the view of the environment. Changes in the economic model led to an important deindustrialization of the AMBA in general and specifically in Munro, and the recognition and acknowledgement of the environmental issues from different sectors of society. In local terms these two issues generated a realization within local government of the effects of deindustrialization and the need to look for alternatives to overcome these effects. The local residents' awareness of the noxious health effects of pollution generated a reaction against existing facilities located on the area. During the '90s there was a growing involvement of middle-upper class residents in environmental issues in general, with an agenda that encompassed the preservation of open spaces, and concerns

---

[57] The photo interpretation found only one case in which an old industry changes into residential uses.

[58] Interview Arch. Ceppi. Planeamiento Urbano, Municipalidad de Vicente López.

[59] According to Vecslir and Ciccolella between 1990 and 2010 the Panamericana highway in Vicente López and San Isidro provided the highest space supply for national and multi-national corporate offices and service sector activities in the metropolitan region.

about new infrastructure and land development, pollution, etc. In the case of Munro, middle class residents vigorously addressed industrial pollution issues through different approaches. A group of residents and some notable individuals organized themselves to protest against industrial pollution and the associated health risks, demanding measures to prevent and mitigate these effects. Two different groups of residents focused their demands on two particular industrial facilities, Atanor and Diacrom.[60] Each group targeted the industry that directly affected them. Despite some commonalities of their claims, they did not create a common cause against pollution.

The case of Atanor started in 1997, as a consequence of the residents' concerns about health related issues and odors that emanated from the plant. They argued that as a result of Atanor's use of chemicals, some people had been affected with cancer and respiratory diseases, and that some were children born with malformations.[61] Through the local and national media they voiced their demands and informed the general public about the plant's negative health effects as a consequence of pollution. This highly active and organized group of a relative small number (24) of residents demanded that Atanor stopped using certain chemicals in the plan, specifically thallium, and they also demanded the cleanup of the contaminated soil and the eventual relocation of certain types of noxious industrial production sites. Furthermore, they requested more local and state control over the emissions, and the need for health programs that would protect and prevent health damages to nearby residents. However, these claims were far from being accepted by the rest of the neighborhood. Instead, one sees different and opposed

[60] Atanor produces agrochemicals, chemicals and petrochemicals. It specialized in derivates of methanol, such as formol, and phenol resins and urea resins. Atanor is operating in Munro since 1940 and has around 700 employees. Diacrom is hard chrome planting located in Munro since 1953.

[61] Interview Sr. Carlos Longarini (2009).

reactions to the environmental demands. The small group's claims against Atanor were pushed by residents who lived in close proximity to the plant, but who were not related to the industry and who had often moved relatively recently into the area. Meanwhile, other local residents who worked in the plant often rejected these proposals. Moreover, these two groups took different measures: while the opposing group opted to build pressure against the plant through the media and to put pressure in the local and provincial government, resident employees of the plant collected signatures in support of keeping the facility operating.[62] This conflict of interest with the industrial workers did not prevent the residents to continue with their demands.

As a result of these conflicting and albeit contradictory pressures the facility was temporarily closed down on several occasions and some residents did receive health treatment. In 1997 for example, Atanor was closed down for 45 days due to an alleged polluting incident (Bistagnino 2003) in which 24 people received treatment from the national government for intoxication from thallium.[63] In 2004 some residents demanded through the courts another closure after another 60 cases of contamination from thallium that was believed to come from Atanor a local newspaper reported (2004). In the same year, the Secretaría de Política Ambiental de la Provincia de Buenos Aires (Secretary of environmental policy of the Buenos Aires Province) requested that the industry developed a plan to clean up the soil around the facility and to reduce the emissions and wastes into the groundwater. In 2009, the facility was again closed for a short period (Suárez Arocena 2009).

---

[62] Interview Mss. Maria Luz Ledesma (2009).

[63] "There were 22 out of 25 people with high levels of thalium in their bodies" (Interview Mr Carlos Lonagrini 2009).

In the last 13 years, local residents have been actively engaged in pursuing their demands, and while the facility has been closed for short periods of time and the odors have diminished,[64] there are still complaints about the level of industrial pollution, the lack of response of the local government, and the lack of health programs tied to environmental pollution.

The second case analyzed here – that of Diacrom – begin in 1995 as a consequence of the residents' concerns about health related issues, odors and effluent emanating from the plant. They argued that Diacrom's use of chrome had directly caused several cancer cases.[65] Moreover, they also claim that filtration of chrome from the plant had reached a water mains that provide drinking water to five jurisdictions (Vicente López, San Isidro, San Fernando, Tigre y San Martín), and had also contaminated the ground water.[66]

A group of residents led by Ms. Maria Luz Ledesma -- a very active and involved resident -- started to mobilize the residents and collected 400 signatures requesting the environmental remediation of the area, the creation of new water networking system, and the re-localization of the plant given the highly contaminating materials that it employs for production. Residents actively promoted the issue through the media, but in contrast with Atanor, they also built strong links with other environmental NGOs and took Diacrom to court. However, even though several residents were committed and engaged, the group was not cohesive enough to follow through with their demands. In order to

---

[64] Interview Mr. Carlos Longarini (2009).

[65] Interview Ms. Maria Luz Ledesma (2009). According to her by this time there have been 17 deceases by cancer.

[66] In 1995, Aguas Argentinas, the company that provides drink water to most of AMBA, started a lawsuit against the company for water contamination.

maintain the momentum and to bring the case to public notice and to take the legal actions they contacted some environmental NGOs. In 1999 Ms. Ledesma and some NGOs started civil and criminal lawsuits against Diacrom.[67]

The firm was temporarily closed by the Secretaría de Política Ambiental (Province of Buenos Aires) and the local government for contaminating the groundwater with chrome on two occasions (2007). Facing these closures the firm argued that the pollution was empowered by public authority in 1956 when the company was allowed to dump chrome into a septic pond/tank. Furthermore, they argued that pollution had not spread beyond the original designated dumping area (Appeal, Diacrom, May 2009).[68] In 2008, the San Isidro's court ruled that the province should be responsible for the environmental clean-up of the affected area (Villasante 2008).

The groundwater contamination was mainly due to the lack of technological upgrades over time; "several tanks involved in the galvanization process were in bad condition",[69] and in 2008 these tanks were closed (2008), not least since galvanization was no longer used at the site.[70] These legal arguments continue and according to one informant it has been very difficult to define the responsibilities of each of the actors involved. On one hand the firm denies its responsibilities arguing that it follows

[67] Asociación Civil Pro Vicente López, Fundación ECOSUR and Asociación Argentina de Abogados Ambientalistas.

[68] This is an argument in the Sentence of the Court of appeal on the DIACROM s/presunta infracción a la ley 24.051. Causa 2669 (2009).

[69] Interview Ms. Maria Luz Ledesma (2009).

[70] Interview Ing. Foscaldo (2009). Departamento de Seguridad e Higiene, Municipalidad de Vicente López.

regulations that were in place at the time of siting, and on the other the state's responsibilities are not clearly drawn between the local and provincial government.[71]

It is clear that since the 1990s, there has been a change in the general public's perception of industrial facilities. While historically they have been seen as a source of employment and economic development, with the emergence of the environmentalist agenda, people's concerns about environmental quality have risen and local residents have begun to perceive these industries as a major threat to their health. However, the opposition groups do not necessarily represent the majority views.[72] These cases show the middle class residents increasing concerns about the health effects of pollution and also their capacity to organize themselves to reject polluting industries and to make public the issues environmental contamination. Even though there is a limit to establishing a direct causality between each facility's emissions and health impacts, their actions have had an important impact in public awareness of pollution consequences. However it remains unclear what effects those claims have had upon local environmental policies.

With regard to middle-class attitude towards polluting industries, Munro shows that the middle-class has organizational capacity, power relationships and influential social networks which allow them to react, and to a certain extent to distance themselves from, noxious urban environments. This case is clear in the sense that even though the facilities are still operating in the area, residents got some law enforcement to control the level of industrial emissions, and to relocate some of the most polluting activities of the plants away from the neighborhood. On the other hand, the environmental blackmail also

[71] Interview Dr. Mariano Aguilar (2009). Fundación Argentina de Abogados Ambientalistas.

[72] Interview Arch. Ceppi (2009). Planeamiento Urbano, Municipalidad de Vicente López.

holds in this middle-class neighborhood, where blue-collar residents were willing to support the presence of polluting industries in order to get employment.[73,74] Even though there are many possible explanations, it appears that those who view industries as important providers of employment are less likely to engage in environmental claims against the industries.[75]

Another important aspect is that despite the fear of the pollution's health effects people do not appear to want to move away from the area; instead they demand that the industries take measures of environmental remediation. Furthermore, they hope that as a consequence of their mobilization, these industries will gradually move to other locations, and that no new facilities will locate in the area.

Barracas al Sur - Partido of Lanús

Lanús is situated in the lower part of the Riachuelo basin, one of the most polluted places in Argentina.[76] As the other partidos in this section of the Riachuelo basin, Lanús has historically been an industrial area given its relative location close to the city of Buenos Aires and its high accessibility to the port of Buenos Aires. Furthermore, the

---

73 Environmental blackmail occurs when residents out of need for local sources of employment are forced to accept polluting sites and, hence, be exposed to pollution (Bullard, 1990).

74 This is a distinctive characteristic of the Argentinean industrial workers that traditionally belong to the middle class compared to the US.

75 According to Schweitzer and Stephenson (2007) the ensuing divisions in the citizenry reflects the latent tension between issues of neighborhood self-determination and community wide claims, as well as environmental, civil and economic rights (p.327).

76 According to the Blacksmith Institute, the Riachuelo basin is one of the 30 most polluted sites or areas in the world. See http://www.blacksmithinstitute.org/wwpp2007/finalReport2007.pdf

agglomerations of industries in the surrounding jurisdictions such as the industrial areas in the south of the CABA, and in the partido of Avellaneda, have reinforced the industrial role of Lanús. Besides being heavily industrialized, Lanús has a high population density of 10,068.5 hab/Km2 (Dirección de Planeamiento de Lanús 2009).

Compared with the partidos located in the first ring of the metropolitan area, the industrial development in Lanús started earlier as an extension of the industrial development of the capital city. In the early industrialization stages, Lanús hosted the salting houses and later the slaughter houses, meat processing plants, and leather by-product industries, with a subsequent diversification into others industrial sectors (such as textiles and metal engineering). Although de-industrialization of the AMBA during the 1990s and the economic crisis affected the industries located in Lanús, the industrial sector remains the predominant economic activity. Today, Lanús has 5,600 industrial facilities (that include food processing plants, textiles, paper, plastics, metal engineering) among which, are 400 leather tannery industries. Although the sector fluctuates according to economic cycles,[77,78] this activity has the highest labor demand in Lanús (Dirección de Planeamiento de Lanús 2009).

---

[77] Interview Mr. Tortosa (2009). According to Mr. Tortosa the leather industry is very sensible to the economics' cycles.According to Mr. Tortosa and Mr García, the golden age of the tannery industry was 1980s were there were 450 facilities; by 1970s there were 240 tanneries. During the 1990s the number declined drastically to 50 tanneries and increased considerably after 2000 reaching a total of 130. Today, according to the Municipality of Lanús there are in total 400 tanneries operating in the whole partido of Lanús.

[78] Interview Mr. Eduardo García (2009) President of UCA (Unión de Curtiembres Argentina- Argentina Tanneries Unión); this Unión groups Pymes (Small and middle size industries).

Since the beginning, industries and urbanization grew together without any type of control or zoning regulation. The neighborhoods close to Barracas al Sur historically hosted the leather industries. Most of these industries are family-based industries that flourished in the early industrialization stages in Lanús and were created by European immigrants.[79] Along with industrialization, immigrants urbanized the areas surrounding the facilities and created working-class neighborhoods. In this historical process the industries arrived first bringing urban services and opening u low cost land for urbanization.[80] However, the actual neighborhood of Barracas al Sur had a more recent development closely related to the tanneries and to the availability of vacant land.

Most of Barracas al Sur settled on public land owned by the Province of Buenos Aires. At the beginning much of the area was owned by the Talleres Metalúrgicos San Martín S.A., but by the end of 1960s it was expropriated by the national government. Even though this was an important piece of vacant land that covered 330 hectares, its poor environmental conditions constrained the type of activities that could be developed. At that time, the Secretaría de Desarrollo Urbano y Vivienda considered that the land was not suitable for housing development because it was in a flood zone 2 meters below the sea level. Consequently, the federal government considered other alternative uses such as a landfill for the CEAMSE and a public sports center. None of these ideas prospered, however, by the beginning of 1980 the federal government transferred the land to the

[79] Interview Arch. Ricardo Jelik (2009). Secretario de Gestión Ambiental, Municipalidad de Lanús.

[80] Interview Mr. Tortosa (2009).

Province of Buenos Aires.[81] A report from 1984 states that the land was used as an illegal landfill known as "la quema", which received industrial effluents and building materials (Direccion de Vivienda de la Municipalidad de Lanús 1984). In addition to the environmental conditions of the area, the report mentioned that there was a permanent threat of land invasions.

The relationship between the leather industry and Lanús' local government has been very close. The local government has always supported the leather industry considering it a key sector in the local economy. Mr. Quindimil, [82] Lanús city mayor, had the idea that Lanús should be a working class municipality,[83] and that the tannery industry played an important role in it. According to Mr. García, mayor Quindimil "fought to protect the development of this sector in Lanús."[84] From the firms' perspective Lanús offered political support and locational advantages that allow them to remain as the main leather industrial cluster in Argentina. This cluster allows the middle and small size industries to join forces to compete in a market that tends to monopolize the leather production around few big industries.[85]

---

[81] Note from the Ministerio de Economía y Hacienda de la Nación, 1980.

[82] Mr. Quindimil was the mayor of Lanús during the periods 1973-1976 and 1983-2007.

[83] Interview Arch. Alfredo Garay (2009).

[84] "Quindimil was so proud of the sector that any time that higher levels of government put pressure on us he defended our sector, once in a meeting with the provincial government he said …this is my main industry and you will not touch it." Interview Mr. García (2009).

[85] According to Mr. García the advantage of being in Lanús is that being a part of an industrial He said "Dios esta en todas partes, pero atiende en Buenos Aires. Interview Mr. García (2009)

The industrial eradication and decentralization policies implemented by the military regime during the 1970s put pressure on the tannery sector to move outside of Lanús. The federal government's main argument was that these LULUs (Locally undesirable land uses) created serious environmental risks to the highly dense population of the AMBA.[86] Given the important position of the sector in the local economy, the locational advantages and the unfeasibility to relocate this activity, the tannery association ACUBA (Asociación de Curtidores de la Provincia de Buenos Aires) started to negotiate alternatives with the federal government to minimize industrial pollution in the area. ACUBA proposed the creation of a treatment plant for waste disposal.[87],[88]

By 1982, ACUBA agreed to build a waste treatment plant that would serve the tannery industries located in Lanús Oeste. The provincial government transferred the public land to ACUBA in usufruct for a period of 50 years, renewable for a further 50 years. By 1982 ACUBA agreed to build a waste treatment plant that would serve the tannery industries located in the area of West Lanús, and the provincial government transferred to ACUBA the public land needed in order to build the plant and gave it use rights over the land in for a period of 50 years, also renewable for a further 50 years. By 1985, ACUBA started to build the treatment plant funded by its members' donations.

---

[86] Other authors like Schavzner argue that the real motive to decentralize the industry was to disperse the immense labor force in order to have more control over the Unions.

[87]At that time, there were more than 240 small and middle size facilities operating in Lanús.

[88] Interview Mr. Tortosa (2009). Mr. Tortosa was the ACUBAS delegate that negotiated with the federal government the transfer of the land for the treatment plant of waste disposal.

With many problems the treatment plant was partially built and operated without government approval for 5 years until 2000.[89] Since 2000 the treatment plant is no longer in operation. The problems of the industrial effluent disposal have not been solved, and the local government and the sector are still trying to find ways to create a common waste treatment plan for small and middle size facilities operating in the area.[90]

Industrialization and urbanization developed together in Lanús. By 1940, most of the partido was urbanized and consolidated, but Barracas al Sur had the biggest area of vacant land in Lanús. By 1963 in Barracas al Sur only 45 percent of the area was urbanized and there were 180 hectares of vacant land. Throughout the years this land represented an opportunity for both firms and population to settle in the area.

Table 5.2 shows the neighborhood's evolution in terms of residential and industrial land uses. The historical analysis show that between 1963 and 2008 residential areas duplicated from 80.4 ha to 167.9 ha respectively. The highest increases in residential uses took place before 1992. At the same time, industrial land uses also increased from 21.2 ha to 31.7 ha. However, during the 90s industrial areas considerably decreased as a consequence of the closing of the Fábrica Militar de Aceros, which accounted for 52 percent of the total industrial land uses in the area in 1984. By 2008 industrial land uses increased 77 percent with respect to 1996. Maps 5.3 and 5.4 show, colored in purple, the evolution of industrial facilities and storehouses. In terms of their

[89] Interview Mr. Tortosa (2009).

[90] Today small and middle size leather industries are grouped in UCA (Unión de Curtiembreros Argentina).

spatial distribution, industrial facilities and storehouses gradually scattered across the area. New industries and industrial storehouses located towards the east closer to Valentín Alsina's industrial cluster, through an infill process along with the consolidation of squatter settlements. From the end of the 1990s, new industrial facilities emerged at the Riachuelo's shore. By 2008 large industrial facilities (Urciollo, Giordano and Gaitán) consolidated an important industrial cluster along the Riachuelo. These industries account for 59 percent of the total industrial land uses in the area. It is interesting to note that fluctuation in the industrial land uses mainly responded to the closure or opening of big industrial facilities, while the presence of small facilities tend to steadily increase throughout the whole period.

Over the same period there has been a significant increase of residential areas; mainly driven by a systematic advance of informal settlements

The scale of the informal settlements development is quantified in table 5.3 and throughout the period informal settlements increased their share in the total residential area from around 20 percent in 1963 to 58 percent in 2008. Within this informal housing market there was a change in the actors' strategies of occupation. The strategies switched from the creation of 'villas' (shanty towns) to 'asentamientos' (squatter settlements).[91] Unlike the first 'villas de emergencia' that settled around 1930s in Villa Jardín adjacent

[91] These modes of illegal occupation differ in the spatial aspect of occupation as well as in their organizational capacity. While villas de emergencia were mainly developed in the 30s and 40s by rural population that moved into the city they are characterized by an irregular geometry, with high density and are a result of individual practices; the asentamientos have a regular geometry, organized and planned by urban population with the objective of regularization (Cravino 2008).

to the Fábrica Militar de Aceros, all the subsequent occupations were ‘asentamientos’ (squatter settlements).[92]

The spatial evolution of these areas was traced in Maps 5.5 and 5.6. The maps identify the shanty towns (in yellow), new squatter settlements (in red), consolidated squatter settlements (in brown) and formal residential areas (in gray). The maps show that the increased of residential areas was driven by a systematic expansion and consolidation of informal settlements around ACUBA’s area. As can be observed, since 1963 to 2008 the shanty-towns and formal dwellings remain almost stable and went through a consolidation process, while the informal settlements expanded and occupied public vacant land. The maps and table 5.3 show that new settlements mainly developed between 1971 and 1984. From 1984 there was a consolidation and densification of these settlements and a growth of some squatter settlements into the flood-prone areas surrounding ACUBA towards the Riachuelo.

By the time the national government transferred the land to ACUBA in 1983, some residents, 438 families in total, that shared their houses with relatives in previous squatter settlements in the area, occupied part of the vacant land (Direccion de Vivienda de la Municipalidad de Lanús 1984). According to Gallucci, while the occupations before 2000 were undertaken by relatives of families living in neighboring settlements; the last invasions were more organized and brought population from other partidos and even from bordering countries.

---

[92] Interview Ms. Ana Gallucci (2009). Social Worker, Municipalidad de Lanús.

In a context of fight over the land the actors developed different strategies. The local political power let the land occupations happen.[93] Lanús city's Mayor was permissive with both firms and occupants; moreover, Quindimil's government was an important piece in putting the puzzle of poor and industries together in Lanús. On one hand politicians promoted the permanence of the leather factories because of the benefits for local economy; while on the other, as in many other cases in Latin America, the organized invasions of land were used as a political tool to build up a constituency and a power base (United Nations Human Settlements Programme 2003). The political approach to this conflict of interests was that of no intervention.

From the firms perspective it was necessary to protect their rights over the land. According to Mr. Tortosa: "In order to protect the land and avoid invasions we requested the presence of a police station, but we never got one, so we used several strategies to persuade these people not to take over the land. We built a kind of police station and gave it to a retired superintendent. We also gave one area to a person who put a pigs' farm and on the other side of the lot we built a wall… One thing that we took for granted: we could not bother Mr. Quindimil with our disputes…"

The conflict over the land in ACUBA is still going on. Throughout the years (1960-2009) the vacant land was progressively occupied by squatter settlements (see

[93] Interview Mr. Sergio Gonzalez (2009). Foro Hídrico Lanús.

Maps 5.5. and 5.6.), and several attempts to occupy ACUBA have taken place recently.[94]

Meanwhile the firms continue to demand a solution over the treatment plant.

[94] Most of the squatter settlements have been regularized in terms of titling. At the present time, the local government is going through regularization process of the more recent squatter settlements and is relocating a small fraction of them which are located in the Riachuelo's shore.

Table 5.2. Land Use Changes

Barracas al Sur - Lanús (1963-2008)

Year	Total residencial land uses (ha)	% of change Residential Land Use	Residential Land Use Change	Total Industrial land uses (ha)	% of change Industrial Land Use	Industrial Land Use Change
1963	80.4			21.2		
1971	105.7	131	31.5	24.4	115	15.3
1984	131.8	125	24.7	30.7	126	25.7
1992	143.2	109	8.6	22.9	75	-25.5
1996	151.6	106	5.8	17.9	78	-21.8
2008	167.9	111	10.8	31.7	177	77.1
Total % of change			**81.4**			**70.8**

Source: Author's compilation based on the interpretation of aerial photographs.

* Total area 330 hectare
**Land Uses Areas do not include open spaces and streets areas.
***The facilities areas are base on the photo-interpretation of aerial photographs for each year. All facilities detected are included in the estimation and it is likely that some of them may not be operating at the time the picture was taken.

Table 5.3. Residential development.

Barracas al Sur - Lanús (1963-2008)

Year	Formal dwellings	Shanty Town	New Squatter Settlements	Squatter Settlements	Total Residential Area	Total Informal Residential Area	% Informal residential areas*
1963	65	8	8	0	80	16	20
1971	64	10	15	8	106	33	31
1984	69	11	17	35	132	62	47
1992	70	11	4	58	143	73	51
1996	70	11	2	69	152	82	54
2008	70	11	8	79	168	98	58

Source: Author’s compilation based on the interpretation of aerial photographs.

* This percentage shows the proportion of settlements that were informally developed at the beginning; even though, some of them may have been regularized.
**Areas Measured in hectare.

Map 5.3. Barracas al Sur – Industrial Land Use Change

Period 1963-1984

1963 **1971** **1984**

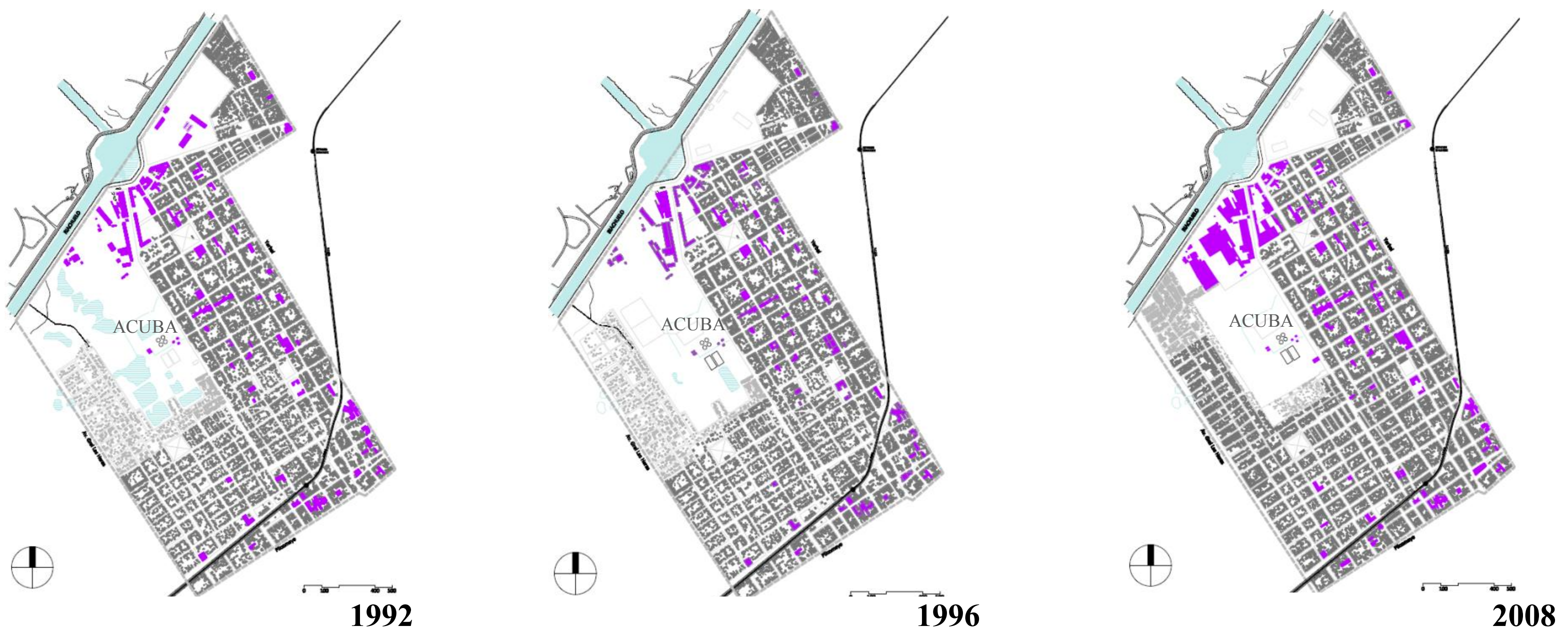
References:

Industries and storehouses — Consolidated residential areas — New squatter settlements

Source: Author’s compilation based on the interpretation of aerial photographs.

Map 5.4. Barracas al Sur – Industrial Land Use Change

Period 1967-1983



References:

Industries and storehouses

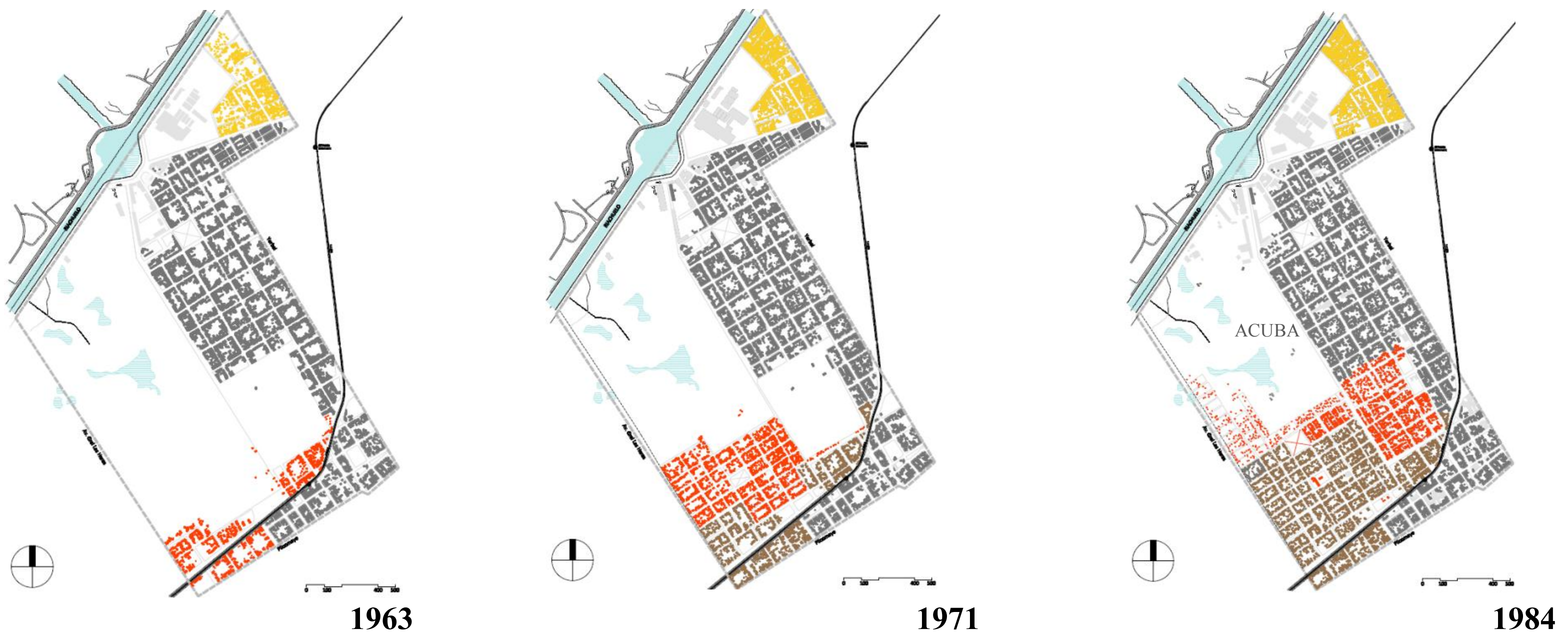
Consolidated residential areas

New squatter settlements

Source: Author's compilation based on the interpretation of aerial photographs.

Map 5.5. Barracas al Sur – Residential Development

Period 1963-1984



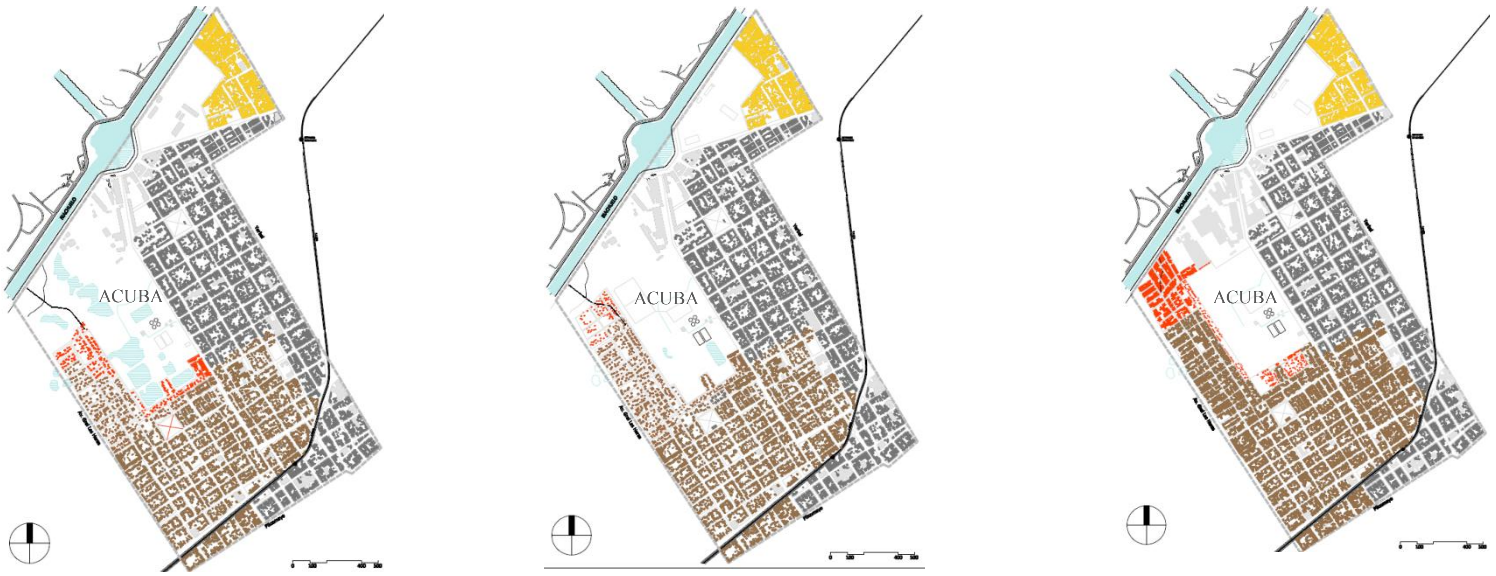
References:

Shanty town — New squatter settlements — Consolidated squatter settlements — Formal residential areas

Source: Author's compilation based on the interpretation of aerial photographs.

Map 5.6. Barracas al Sur – Industrial Land Use Change

Period 1992-2008



1992 **1996** **2008**

References:

Shanty town | New squatter settlements | Consolidated squatter settlements | Formal residential areas

Source: Author’s compilation based on the interpretation of aerial photographs.

On the issue of the population's employment there have been changes in the last 30 years. The availability of land and political conditions allowed for the development of these settlements, but employment opportunities in the area was also an important factor for the urban poor to locate in this area of Lanús. According to Gallucci "most of the men work in the industries and the women work as maids" (Direccion de Vivienda de la Municipalidad de Lanús 1984). Affected by changes in the economy and in the labor market, the new population's main activity is no longer quite related to the industries, but rather to the informal economy. The west and south areas of Barracas al Sur mostly gravitate around the collection and recycling of wastes generated in the central city (mainly paper and plastics).[95]

As mentioned above, the urbanization and industrialization of Lanús was developed without any type of regulations. It is not until 1970 that the zoning ordinance 1038/70 established the land-use regulations. In that ordinance most of the partido has mixed land uses (industrial and residential) with less than 15% included as exclusively residential. Exclusive industrial land uses are mostly concentrated along the Riachuelo River. Barracas al Sur was defined as exclusively industrial on the Riachuelo's shore and mixed land-use in the remaining. The industrial fate of Barracas al Sur was assured during the 2000s: in 2006 the local government promoted the creation of the Tanneries Industrial Park in Barracas al Sur that would gather more than 60 facilities tied to a common treatment plant (2-7-2006, Infobae.com), but the scale of such a project made it

[95] Interview Arch. Ricardo Jelik (2009). Secretario de Gestión Ambiental, Municipalidad de Lanús.

non-viable.[96] A new zoning ordinance (Decreto 490) was proposed in 2009, and while recognizes the current situation, it seeks to limit the expansion and concentrate activities in exclusive industrial areas.[97] The areas with C3 industries were reduced to three specific areas in the Partido. The normative zoning also recognized the "grandfathered rights of non-conforming land uses.[98] According to this zoning proposal Barracas al Sur concentrated exclusive industrial land uses in ACUBA's area and mixed land-uses that combine industries class 1 and residential uses in the existing residential areas.[99]

Environmental concerns in Lanús rise as a consequence of the degraded environmental conditions of the Riachuelo. During the 1990s the critical situation of the Riachuelo basin became part of the governmental and social actors' agenda. Given that Lanús is a part of the lower basin and it has a significant concentration of polluting activities, industrial production has been part of the debate. Despite the many claims made by NGOs through the judicial system in 2000 to control pollution, little has been achieved in this field. The environmental consequences are important and acknowledged by politicians, firms, and the community; however, the economic role of the industrial activities prevail over that of the environmental issues. For many, the predominance of

---

[96] Interview Mr. García (2009) Unión de Curtiembres Argentinas.

[97] Interview Arch. Ricardo Jelik (2009). Secretario de Gestión Ambiental, Municipalidad de Lanús.

[98] Non-conforming uses: Existing land uses that are not affected by new regulations because they were legally built under former codes or different classifications.

[99] Refer to industrial classification in Chapter 2.

the leather tannery sector is considered the "leit-motif" of Lanús today.[100] From the firms' perspective, local and federal government do not yet to provide the necessary support to address the industrial waste treatment, which according to them cannot be solved by small and middle size firms alone.[101] Local government and some NGOs argue that the industries should remain in Lanús, but they need to have technological improvement in order to become clean industries.[102] Furthermore, they agree that firms should be socially responsible for the negative effects that they cause on the environment, and the effects of pollution on the population are acknowledged by different sectors. However, local officials state that the need is to solve their immediate needs which are those of land titling and housing, even though this implies no remediation of polluted ground.

CAUSAL PATHS

The relationship between sources of environmental pollution and population is extremely complex. No single factor shapes this relationship, but rather it is the result of a confluence of socio-economic, institutional and market processes which might combine in different ways over time. It is the variations of these configurations of factors and processes which defines the continuity or change of the industrial trajectories

[100] Interview Arch. Ricardo Jelik (2009). Secretario de Gestión Ambiental, Municipalidad de Lanús.

[101] Interview Mr. García and Mr. Tortosa (2009).

[102] Interview Arch. López Arroyo (2009). Secretario de Planeamiento Urbano, Municipalidad de Lanús.

of each of these case studies. This study indentified three external factors as the most relevant in the historical development of the cases covered by this study. These include: i) the process of de-industrialization of the AMBA. This was a consequence of the liberalization of the economy and decentralization policies that began in the 1970s and several economic crisis which significantly affected the AMBA's industrial base. ii) The second factor is the neighborhood or adjacency effect. This refers to the characteristics and the processes that occurred in the surrounding areas of the neighborhoods (i.e. presence of industrial clusters, changes in economic activities, etc.). iii) The final factor is the emergence of the environmental agenda. This aspect is relevant in the sense that changed the social perception about industries, especially about industries those that developed polluting activities. While industrialization was historically perceived as source of progress and development, the rise of the environmental agenda created concerns about the health effects and the impact of these activities in the quality of the environment. This contributed to change societal perspectives about industrial activities and motivated collective actions among certain social groups and social mobilization against polluting industries.

Economic changes have differential effects on the development of industrial sectors and also affect the local government future economic strategies. The process of de-industrialization caused the closure of some firms, but also shaped firms' resistance to closure or relocation as well as their active support of efforts to consolidate industrial activities in their historical locations. It also represented a challenge to local governments' economic strategies and their strategies differ in both cases. For instance, in the case of Munro, the local authorities seek alternative economic development strategies for the area. In Barracas al Sur, on the other hand, local authorities supported the existing industrial base located in the area. The emergence of the environmental agenda and the access to information shaped residents' perception of environmental issues and industrial pollution Changes in these perceptions also contribute to explain who engaged against polluting industries and how. Furthermore, the level of social opposition and mobilization against polluting industries differs considerably between the two case studies, and help explaining the different industrial trajectories between the two cases. For instance, as figure 5.1 illustrates, residents' mobilization in Munro constituted an important factor in the reduction of polluting activities in the area.

Finally, in addition to the factors mentioned above, the adjacency effects of the relative location of these areas in the metropolitan space constitute a third factor that indirectly contributes to either reinforce industrial trajectories or helps to develop alternative trajectories. For instance, the tendency towards the location of service activities in the northern corridor of the AMBA contributed to the strategy of the local government to promote other activities rather than industrial activities.

The confluence of these external factors clearly affects the trajectory of both Munro and Barracas al Sur in a substantive way. By establishing the context in which the different actors operate, these external factors create incentives and disincentives to promote the continuity of industrial activities in the areas. Moreover, the combination of these factors defines the neighborhoods trajectories and the final outcomes. The following analysis examines how some common events and trends translate into different challenges in Munro and Barracas al Sur as a result of their interactions with ongoing local processes. Figures 5.1 and 5.2 illustrate the causal path and interactions among factors and actors that lead to the current outcomes in both case studies; they show how external and local factors operate in shaping the destiny of these two neighborhoods.

Figure 5.1 illustrates the case of Munro and figure 5.2 refers to the case of Barracas al Sur. The arrows represent the relationship between factors and actors and the direction of the effects. The line thickness and the colors weight the intensity of the effects, the red lines represent the most relevant causal factors that determined the final outcomes; the black ones represent the association between factors being the thicker ones the most important.

Figure 5.1. Causal Path - Munro. Negative Case – Moderating Environmental Externalities

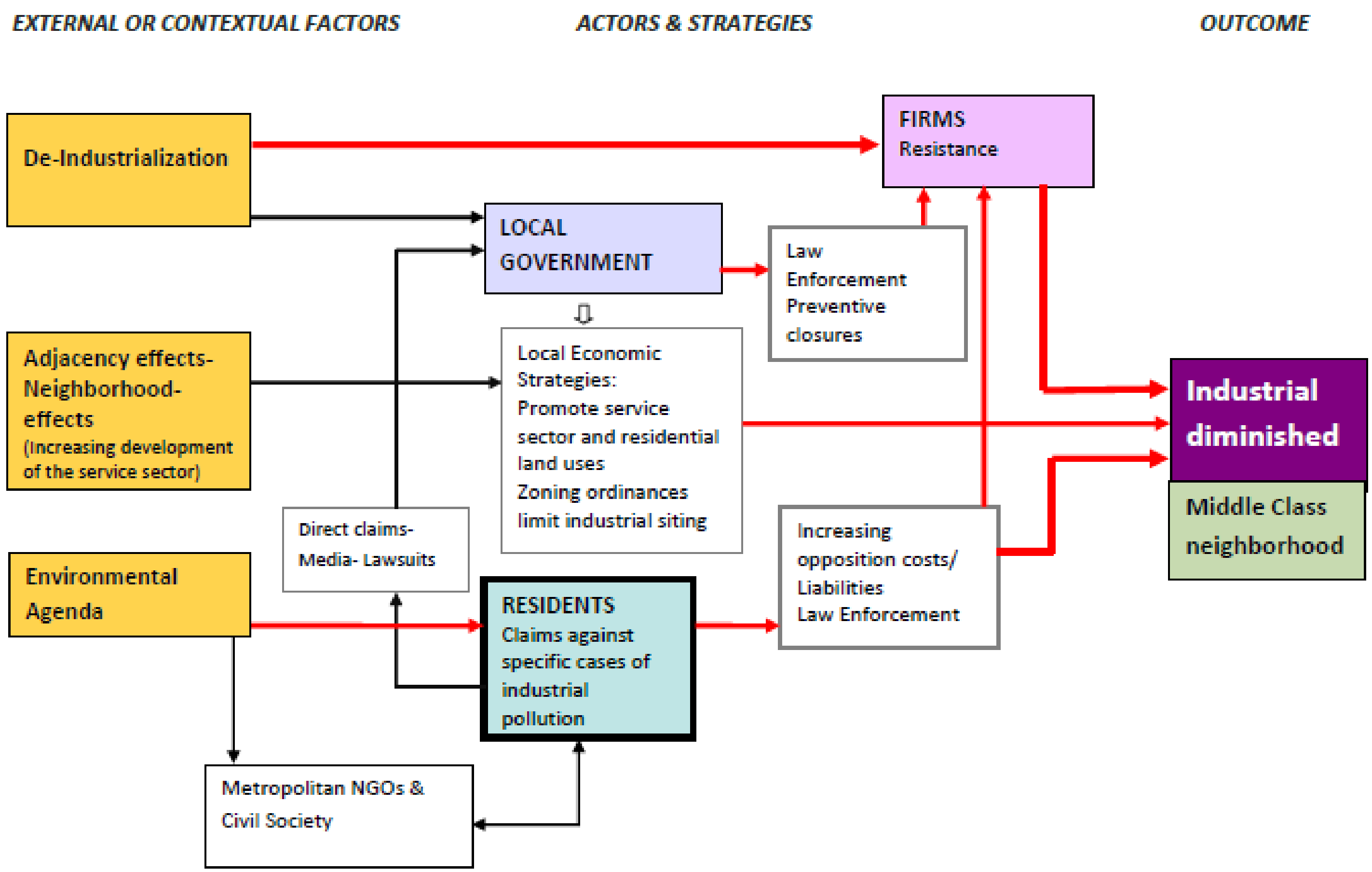
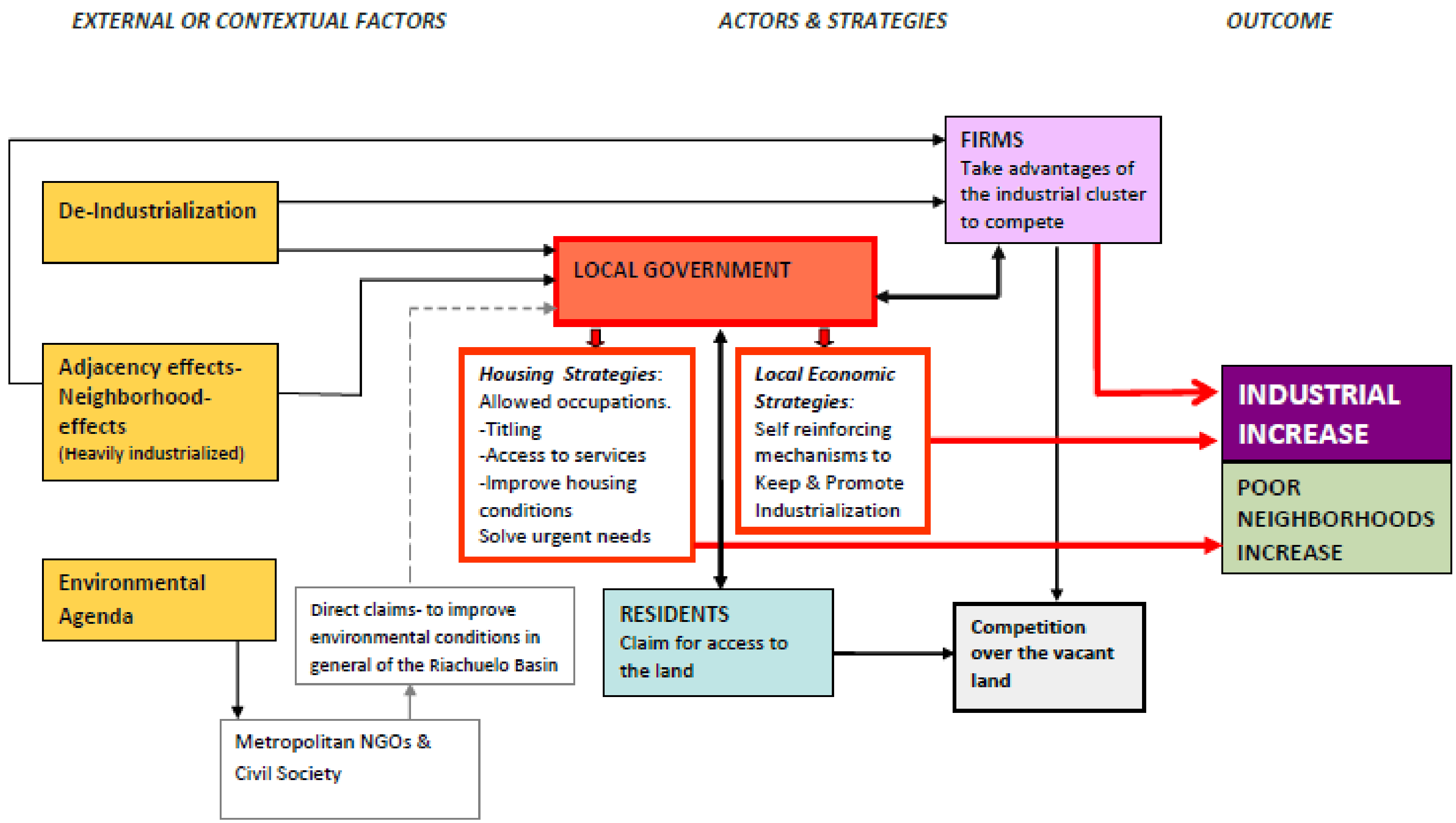


Figure 5.2. Causal Path - Barracas al Sur Positive Case – Exacerbating Environmental Externalities



Munro: Moderating Environmental Externalities.

The case of Munro showed an early consolidation of both industries and working class neighborhoods established before 1967. In this case, external factors influenced the local trajectory from a heavily industrialized area (1930-1992) toward a slight reduction of the industrial presence by 2008, in terms of industrial area and the type of production. The unfavorable economic conditions for the industrial sectors located in Munro forced the closure of some facilities, however, this explains the reduction in the number of industrial facilities, but does not necessarily explained the relocation of polluting activities outside Munro. The firms that remain on the area seem to follow a path of resistance in the face of changing economic conditions and increasing environmental accusations. As part of their strategy to survive, firms rejected environmental pollution chargers. For instance, firms argued that pollution was a consequence of their earlier establishment and modes of production, and that technological improvements have limited the increased of pollution in the area. They try to keep operating in their historical locations because of the location advantages. However, in those cases in which the conflicts were challenged in the court, companies relocated parts of their polluting industrial process outside of the neighborhood (as in the case of Diacrom).

Local government strategies also responded to the changes in the economy and social pressure. In a changing economic scenario, local government strategies tended to focus more on producing incentives to develop alternative economic activities, by establishing restriction to the sitting of industries and encourage alternative land uses by providing specific incentives to the development of service sector and real state. This tendency was reinforced by the development of the service sector in the northern corridor of the AMBA. These features of the Munro case differs significantly from the case of Barracas al Sur, where the local government promoted the increase of the industrial base in the area and where the surrounding neighborhoods contained an important industrial base. This is discussed in the following section.

The environmental agenda has differential impacts on the actors' strategies. As the red arrows in figure 5.1 show, environmental issues mainly impacted on local residents' perspectives and it is through their actions and complaints that the environmental agenda affected the firms. Residents' concerns about the quality of the environment and health motivated their subsequent mobilization. Residents who were affected by the negative effects of pollution got involved in active campaigns against polluting firms making public the health threats that they faced. As shown in figure 5.1 this post-siting opposition has two main effects. First, it place direct pressure on local and other levels of government, which led to an enforcement of existing environmental regulation and the preventive closed down of suspected polluting facilities. Second, it increased the opposition costs faced by firms. It is possible to argue that both effects are reflected in the changes in the industrial production of old industries and may be a factor that contributed to the slight reduction of industrial facilities in the Munro area.[103]

Residents' complaints about the quality of their environment did not cause an active involvement of the local government in environmental policymaking. The local government merely reacted to the increasing social demands about pollution, but it did not actively engage in supporting and promoting an environmental agenda. Instead of being a result of an environmental agenda, the gradual changes in zoning ordinance and policies seems to be part of an alternative economic developmental agenda promoted by

---

[103] Interview Mora Arauz (2010). Fundación Ciudad.

the local government. In this view, Vicente López was beginning to be perceived as a residential and service-oriented district. Thus, while the environmental agenda has had a strong impact on civil actors, shaped their perception, and triggered their mobilization, this external factor has only indirectly affected the local government.

As the outcome in figure 5.1 illustrates in the case of Munro, the final outcome of these complex interactions between external and internal factors shows a slightly decreased presence of industrial facilities and no changes in the social composition of the neighborhood. In this sense, the trajectory of Munro shows a strong inertia in the neighborhood characteristics, but gradual changes occur as a consequence of the unfavorable economic context that affected the firms, the new economic development choices made by the local government, and residents' demands against pollution.

It is important to mention that although there was an increasing social awareness of the environmental and health-related problems of industrial pollution among middle class neighborhoods, only a few local groups and networks were actively involved in campaigning against polluting industries.[104] In this context the environmental blackmail argument does not only occur with the poorest groups, as the literature strongly emphasizes, but it mainly applies to the blue-collar middle classes who are willing to accept the trade-off between employment and environmental quality. The environmental agenda and health related issues are directly captured in the residents discourse and several NGOs campaigning against environmental pollution. Furthermore, residents

---

[104] There are two distinctive factors that help explaining the level of involvement of local residents in the local environmental protests: the time living in the neighborhood and the relationship with the firms. According to most of the interviewees those that protest against the facilities and mobilized the other residents are mostly new comers that moved to the area around the 80s and 90s and do not work in direct relationship with the industrial sector. Conversely, those that do not involved themselves or are in favor of keeping the industries in the area tend to be residents that spend most of their life in daily contact with the industries or work in them; for them this is the way the neighborhood always was.

claimed their rights to a healthy environment and argued that the local government is responsible to guarantee it. Contrary to some of the environmental justice literature in the United States that argues that middle class relocate themselves to avoid pollution (Pulido 2000), the neighborhood did not go through a population substitution process. Instead, the middle class engaged in opposition and fought to eradicate the old industries and prevent new industrial developments.

Analytically, the multi-causality of the process of gradual changes affecting Munro relies upon four main elements; i) the duration of the de-industrialization process and its effects on the industrial sectors located in the area; ii) the timing in which the environmental agenda emerged coinciding as it did with the unfavorable economic context for the industries; iii) the strong local protests and mobilization against polluting industries and iv), the layering process that led to subtle changes on zoning ordinances. As the historical analysis of industrial location show the changing trajectory in Munro was one of change from industrial production to the service sector. The economic context is also an important factor to explain the changing strategy of the local government. Deindustrialization forced the local government to adapt its economic base to the local and global changes in the economy. The coincidence of the long deindustrialization process and the emergence of the environmental agenda contributed to the effectiveness of the residents' collective action against pollution. This not only added costs to operating firms, but was effective to expel and restrict the local undesirable land uses in the area. Munro illustrates how incipient gradual changes towards the reduction of polluting activities take place in a middle-class neighborhood, where as a consequence of external pressures and contexts, actors modified their strategies in order to adapt, survive and induce changes based on their specific interests. The inertia of industrial uses is strong in the area and gradual changes occurred as a consequence of residents' pressures and as consequence of changes in the local government strategies for alternative economic development. It is the overlay of actors' strategies that induces gradual changes on the industrial trajectory of Munro by reducing the presence of polluting activities and the number of industrial facilities in the area.

Barracas al Sur: Exacerbating Environmental Externalities

The outcome in figure 5.2 shows that, unlike Munro, Barracas al Sur shows both an increased in the number of industrial facilities and poor neighborhoods over time. As described in the historical narrative, the initial condition of the area showed that most of the area was public vacant land with some residential areas and industrial facilities. The land occupation was gradual since 1970s, while at the same time the industrial presence increased over time. Here, both the poor as well as the firms competed over access to vacant land under the permissiveness of the local government.

In the case of Barracas al Sur the external factors -- de-industrialization, location and environmental issues — contributed reinforcing local politics mechanisms to keep the historical path of the area. As figure 5.2 shows in red, the role of local government as a mediator between firms and the poor is central to explain the trajectory of the area. An important difference between the two case studies is that, in the case of Barracas, the environmental agenda has little impact in the local actors' strategies. The demands and complaints facing the local government about environmental pollution were mainly articulated by national or metropolitan NGOs and the judiciary, not by local residents suffering negative environmental externalities.

The historical analyses show that despite the unfavorable economic conditions –especially for the leather tanning industry--, the type of activity, firm size, and the importance of the industrial cluster in the nearby areas make Barracas al Sur a key area to host industries. In an adverse context, firms tend to follow a resistance path against the changing economic conditions and external environmental pressure. A firm's strategy to survive is based on the logic of increasing returns. For them it is essential to remain in the area in order to be competitive in the market. The close relationship between the leather industrial chamber and the local government explains the continuity of these activities despite many efforts to relocate the industries during the military regime. For instance, the unconditional support of the city's mayor, Mr. Quindimil, to the local leather industry contributed to transfer the rights to the land to develop the industrial waste treatment plants. In the same manner, during the 2000s firms negotiate with the local government to reduce pollution through the effluents treatment plant in order to respond to the pollution claims over the Riachuelo River. Despite of these alliances no effective actions have been taken yet to solve the problems of industrial pollution.

Local government adopts self-reinforcing mechanisms to deal with the poor's and firms' demands. This helps to reinforce the industrial presence in the area, while at the same time, it develops policies to improve and upgrade these informal settlements (red arrows in figure 5.2). In short, in the case of Barracas, the local government strategy mainly relies on keeping the status quo. For instance, the 2007 proposed zoning ordinances concentrated highly polluting industries (Category 3) in the area and, at the same time, defined the residential areas around it, following the current spatial distribution. This implies that more polluting industries will be located in the area and, consequently, the poor will be exposed to even greater environmental externalities.

Regarding the quality of the urbanization, as the settlements consolidate there has been an improvement in the access to services. In relation to the most recent settlements, the local government is making efforts to partially address "brown agenda" issues, by providing titling and basic sanitary infrastructure to these settlements without implementing environmental remediation measures.[105]

Regarding the critical levels of environmental pollution, environmental issues are framed in a more general context: the Riachuelo Basin. Civil society's involvement is largely representing by external actors –national environmental and human rights NGOs and the judiciary. Even though these groups pressure the local government through the judicial process, their demands seem to have no strong effects on either the local government or the firms. In the area of Barracas al Sur, environmental issues gravitate mainly around the disposal treatment of industrial effluents in general, and not over specific facilities' as was the case in Munro. The diversity of polluting sources and the lower level of local involvement in pollution issues may be a factor that made the demands less effective.

In deep contrast with Munro, Barracas al Sur suggests that the poor have a different order of priorities in comparison with those of the working middle class. Most of Barracas al Sur was developed by squatter settlements that have consolidated over time. Their priority is to solve their more immediate needs of access to land and housing. In this case the availability of degraded land --a consequence of industrial pollution, garbage dumps, and frequent floods, a permissive local government and political atmosphere—all contributed to the opportunity to develop squatter settlements. Unlike

[105] The main argument for this is that costs will be extremely high and that people will not agree to leave the area because of fear to lose their house. Furthermore, it would be likely that new occupations will take place.

Munro, the environmental blackmail argument does not hold in the case of Barracas. Poor residents accept polluting activities in their neighborhoods, but these activities do not necessarily represent employment opportunities for them. In this case most of the residents living in these settlements work on recycling paper and plastic from Buenos Aires city and not in the industries located in the neighborhood. In this sense, the relative location of the area is essential to their economic opportunities. Furthermore, it is possible to argue that the bad environmental conditions of the land represent an opportunity for the poor to have access to it.

Analytically, the trajectory of trajectory of Barracas al Sur shows a strong inertia to keep polluting industrial activities operating in place, as well as the poor living there. Several processes self-reinforced the original path, but the key factor is how the local government mediates between the different interest groups. The processes include: i) the de-industrialization and its effects on the industrial sectors located in the area, and firms' strategies to survive; ii) the historical process of development of the squatter settlements; and iii) the presence of a strong specialized industrial cluster (adjacency effects). As the historical analysis of industrial location and squatter settlements show, Barracas al Sur reinforced the historical trajectory so poverty and industrial concentration increased over the years. In this way, external factors framed the context, in which local politics and practices defined the neighborhoods' path.

In sum, while external factors set the context, it is local politics that creates self-reinforcing mechanisms in order to follow the existing path. The deindustrialization put in danger an important part of the local economy. Under these circumstances mechanisms for the survival of the industrial sector were activated by the local government and firms together. The historical conflicts around the squatter settlements put pressure over the local government to recognize people's rights. In a very complex political scenario the local government attempted to stop the development of new squatter settlements and began to regularize the existing ones. Additionally, the adjacency effects and the characteristics of the area contribute to limit alternative developmental strategies for this area while reinforcing the industrial concentration. It is the continuation of actors' historical strategies that keep Barracas al Sur in a path of increasing industrialization and, at the same time, keep the poor facing high levels of environmental externalities.

DISCUSSION

The historical analysis provides analytical tools for understanding how contextual and external factors influence the trajectory of both neighborhoods. Furthermore, by considering endogenous factors and actors' strategies, this historical analysis allows for the identification of the relevant aspects that shape the spatial relationship between sources of pollution and population.

These cases show that the initial conditions of the neighborhoods create a strong inertia on future developments. However, along the historical process, external and local factors do affect the trajectories, either reinforcing or weakening them. This study identified three main external factors: economic processes, the environmental agenda, and locational effects. Economic aspects constrained the firms' expansions and options to survive in the market as well as local governments' developmental strategies and housing strategies for the poor. The environmental agenda shapes the perspectives of local residents regarding urban environment and pollution. Finally, the relative location in the metropolitan space constrains or produces incentives to alternative developmental models.

In the case studies these aspects have different effects on firms, local governments and residents. These differences determine the path taken in each case. Munro shows how the three external factors combined to shape actors' strategies that led to an incipient changing trajectory. However, the reasons for supporting this change are very different for each of the actors involved in the process. For firms and the local government, economic and neighborhood effects are the driving factors. Meanwhile, environmental quality is the main concern for middle class local residents. In the case of Munro, external factors contributed to explain the changes in the actors' strategies and the final outcome. In the case of Barracas al Sur, the inertia of the local politics determines the increase of industries and the poor in the area. In Barracas al Sur economic and locational factors induced actors to activate self-reinforcing mechanisms to maintain and increase the existing trajectory. In this case, firms and the local government create common strategies to sustain the current local economic model. Regarding the poor, the local government strategy is to consolidate the existing settlements. Environmental issues are not a central concern of any of the actors in this case.

These case studies offer a deeper understanding of processes and causes that mediate the relationship between industrial pollution and population. Despite the limited generalizability of the findings, the comparative case studies do suggest that middle working-class neighborhoods have more resources and leverage to influence the process of converting the local economic base toward one that is less polluting. However, if this process led to polluting industries relocating in 'less resistance' neighborhoods, then, this would clearly deepen urban environmental inequalities.

CHAPTER 6

CONCLUSIONS

The purpose of this study has been to investigate the driving factors of population exposure to sources of environmental pollution and to determine if poor neighborhoods are disproportionately exposed to negative environmental externalities in the Metropolitan Area of Buenos Aires. This research also examined whether the concentration of polluting industries within neighborhoods of different socio-economic levels varies over time. Finally, this study attempted to determine the causes that drive the continuity and change in the concentration of polluting sources and socio-economic characteristics of the neighborhoods.

Environmental inequalities imply an unequal distribution of environmental cost across society. Such distribution is a result of a complex temporal process determine by different factors and actors' strategies and interests. The outcomes result from a complex process of mediation between interest groups, residents and local authorities. The socio-economic characteristics of the population influence the possibility of facing high levels of pollution. Differentiated privileges in terms of political power, access to information and economic resources, among groups, defined the likelihood to be exposed (Mohai, Pellow, and Roberts 2009; Pulido 2000). Thus, high socio-economic groups use their economic and social assets to avoid and reject pollution while the poor attract it given their limited resources and economic needs (Bullard 1990). Spatial outcomes of urban environmental pollution are considered as a consequence of governmental policies, planning practices and bureaucratic practices framed in a specific decision making process (Bohon and Humphrey 2000; Boone and Modarres 1999; Krugman 1991; Lejano, Piazza, and Houston 2002). Pollution, then, is conceived as a side effect of development policies. The market factors shape the spatial outcomes by siting the facilities in places that present lower costs and greater economic advantages for the firms; this causes a disproportionate siting in poor neighborhoods (Saha and Mohai 2005).

The historical approach adopted in this study offers a holistic view that allow for relating these explanations to disentangle the relationship between polluters and population. Moreover, the historical analysis speaks to the complexity and causality of these processes. Under this theoretical approach the interaction between actors provides a more comprehensive analysis of the phenomena. The process analysis offers a better conceptualization of the complex path that lead to observed outcomes.

The analysis has addressed the association between polluting industries and population from different and complementary methodological perspectives. Implementing a mixed methods approach this research analyzed this association across the study area and traced the processes that defined the observable outcomes in two case studies.[106,107] First, quantitatively, this study uses an exploratory approach to capture the effects of poverty and segregation on the density of polluting industries. The quantitative analysis incorporated global and local models. The global model identified a general association, but it was limited to address local differences. The use of the Geographical Weighted Regression allowed us to analyze the spatial patterns in order to understand commonalities and uniqueness across the metropolitan space, and identifying specific cases in which the poor are exposed to industrial pollution. This methodological approach models the spatial variation of the relationship between poverty and pollution, and seeks to measure the magnitude of unequal exposure. Second, qualitatively, a cross-case comparative analysis was conducted on two different socio-economic neighborhoods to trace the historical process of this association. These case studies allow us to identify the causes of continuity or change in the association between polluting industries and socio-economic characteristics of the neighborhoods and facilitate the exploration of causality by analyzing the processes of formation of the current environmental outcomes.

This study informed us about the level of environmental inequalities and the causes that make these inequalities to increase over time. Beyond the specific findings, this study contributed to the discussion of environmental inequalities in theoretical and methodological terms. From the theoretical perspective this study explicitly digs into the

---

106 The study area covers the 12 partidos of the Metropolitan Area of Buenos Aires that surround the City of Buenos Aires.

107 Recall that case studies were selected in terms of the dependent variable in order to explain differences in outcomes. The positive case is Barracas al Sur in which there is a high concentration of poor neighborhoods and high density of polluting industries, while the negative case is Munro where there is middle-class neighborhoods exposed to high concentration of polluting industries.

causes that influence the level of exposure. From a methodological perspective the research contribution lies in the research design that uses mixed-methods in a complementary manner. Nevertheless, it is important to acknowledge that generalizations of the findings are limited in scope. The choices of the area of study and the case studies facilitated the development of insights that might be otherwise not have been available, this selection imposed certain bounds on the scope of this research. Limitations lie in the fact that the study focuses in one city and only includes part of the metropolitan, and that only two cases studies were analyzed.

The city specific focus prevents us from drawing broader conclusion about Latin American cities in general. In order to overcome these limitations future studies should address the whole metropolitan region to better capture the level of inequality. Furthermore, to draw broader conclusion for Latin American cities, further cross cities comparative analysis need to be conducted.

In the same manner, the generalization of the findings from the two case studies presents some limitations. In this regard, more cases should be analyzed. Furthermore, it would be important to include cases that present variation in socio-economic terms, that is cases that present high level of exposure, but in which middle class collective action is not present and cases in which the poor get involved against pollution. This slightly different approach in the case selection would help to account for the weight that institutional and market factors play in defining the presence of negative environmental externalities.

In the following sections the main findings of this research are presented. First, the main findings of this research are analyzed. Findings regarding the degree of environmental inequalities in the AMBA are presented and I summarize the reasons that drive the dissimilar trajectories of different socio-economic neighborhoods are discussed. Second, the policy implications of this study and a future research agenda are discussed.

MAIN FINDINGS

As stated in the studies' objectives, this research was aimed at identifying the driving factors of population exposure to sources of environmental pollution. The first objective has been to identify if the poor are unequally exposed to sources of industrial pollution at the metropolitan scale whereas the second objective has been to identify whether different socio-economic characteristics influence the concentration levels of polluting industries over time.

Unequal Exposure to Polluting Industries

As shown in Chapter 4, this study found that the effects of poverty and segregation on industrial density vary according to the type of polluting industry considered.[108] These results indicate that while the concentration of hazardous facilities is positively correlated to poverty, the concentration of all polluting facilities is, on the contrary, negatively correlated to poverty. Additionally, for both types of industrial density, segregation has a negative effect on them. This indicates that, at the metropolitan scale, the poor are only disproportionately exposed to hazardous facilities. However, pollution is distributed widely throughout neighborhoods of all social classes when considering hazardous and polluting industries combined. The models indicate that spatial concentration of polluting industries in the AMBA is related mainly to access to transportation infrastructure and to the presence of industrial clusters.

The study also found significant spatial variations in the association between industrial density and explanatory factors in specific locations. The spatial variability (i.e., non-stationary[109]) of the relationships indicate that the specific characteristics of places determine the concentration of polluting facilities. While results show that the poor are not always disproportionately exposed to high levels of industrial density, there are specific cases in which poor and segregated areas are positively and significantly associated to high levels of industrial pollution. Thus, the associations between poverty

[108] Recall that Category 3 industries includes industries that are dangerous because the pose a risk to the population's healthiness and cause serious damages on properties and the environment; while Category 2 industries includes those industries that provoke inconveniences because they disturb the population's healthiness or because they cause important damages on the properties or in the environment.

[109] Recall that spatial non-stationarity exists when the same stimulus provokes a different response in different parts of the study region.

and segregation, and industrial pollution are localized. These relationships show similar spatial associations when considering different types of industries.

These poor neighborhoods are exposed to high level of industrial concentration, and this level is above the average level for the study area. However, both models indicate that poor census tracts positively associated with polluting industries locate adjacent to the areas with the highest level of industrial density, but do not overlap with them. The poor neighborhoods are like wedges that penetrate the heavy industrial buffer that surrounds the city of Buenos Aires. Another interesting feature is that those neighborhoods do not concentrate high levels of poverty; the percentage of poor living in these census tracts is below the average percentage of the poor in each partido.

One possible explanation of these findings is that these models are capturing the development path of the metropolitan area. As we discussed before, up to the 1970s industrialization was the driving factor of urbanization. Industrial areas consolidated around the city of Buenos Aires and then expanded towards the periphery. In this process, generally, working class neighborhoods associated with the industries were developed while the poor occupied the interstices available between the consolidated areas. However, to really capture this process a longitudinal study would be needed.

Neighborhoods Trajectories

Regarding the two neighborhoods analyzed in Chapter 5, the study found that both neighborhoods follow dissimilar paths. In the case of the middle class neighborhood (Munro) exposure to industrial hazards diminished over time. In the other case it worked in the opposite direction, such that in the poor neighborhood (Barracas al Sur) there was an increase in industrial concentration and in the concentration of poverty. The historical context and external factors played an important role in the trajectory of both neighborhoods by shaping the actors' strategies over time. Moreover, the case studies show that socio-economic, institutional and market factors account in different degrees for the association of different socio-economic groups and industrial concentration; moderating the environmental externalities in Munro, and exacerbating them in Barracas al Sur.

The trajectory of the neighborhoods was strongly shaped by the neighborhoods early characteristics such as residents' socio-economic status, the level of consolidation of the areas and the quality of the urban environment. The processes that led to the spatial coincidence of population and industrial concentration differed in the case of the middle-class and the poor neighborhood. In Munro, middle working-class neighborhoods developed around existing industries. The high level of consolidation of the area, since 1960s, constrained the expansion and siting of new facilities. In contrast, in Barracas al Sur the availability of public vacant land not apt to be urbanized due to serious environmental problems represented an opportunity to the poor to access land and, at the same time, to the industries to locate there. While in the case of Munro the process of consolidation of residential areas was driven by the industrialization and the formal land market, in the case of Barracas al Sur, such process was mainly determined by the local government laissez-faire policy that contributed to a permanent dispute over the land between industrial firms and the poor.

The historical context was hypothesized to be important to the trajectory of both neighborhoods. External factors such as the important process of de-industrialization that directly affected and diminished the industrial base of the AMBA, the growth of public environmental concerns during the 1990s and the related escalation of public opposition, as well as neighborhood effects contribute to shape local actors strategies that defined the neighborhoods trajectories.[110] In this context, two different processes occurred in each case study that shaped the trajectory of the neighborhoods: i) actors' strategies slightly modified the trajectory (Munro); and ii), a reinforcing sequence of strategies sustained the same trajectory (Barracas al Sur).

The changing trajectory of Munro was driven by actors' reaction to changing economic conditions and to the environmental conditions. Local government reacted to an adverse economic context and sought alternative economic development strategies;

[110] External factors (i.e. changes in the economic conditions: de-industrialization and economic crisis), the emergence of the environmental agenda and the location of the neighborhood in the metropolitan context significantly affected the paths taken. The economic changes had different effects on the development of the industrials sector affecting local governments' future economic strategies. The rise of the environmental agenda shaped actors' perception of the environmental issues and pollution, this agenda was taken up mainly by middle-class residents. Locational or adjacency effects, that is, the relative location of these areas in the metropolitan area, indirectly contributed to either reinforce industrial trajectories –especially in those cases in which there are specialized industrial clusters- or help to development alternative trajectories.

residents acted in response to environmental pollution; and firms responded to the costs created by polluting, in addition to constrains to expand existing facilities which forces them to relocate part of their production. Together, the combination of these strategies created gradual changes that contributed to lessen the level of concentration of polluting activities.

In Barracas al Sur, on the contrary, the same neighborhood's trajectory was reinforced by the actors' strategies that reacted to the changing context. In this case, local political practices, characterized by laissez-faire played a key role in sustaining the neighborhoods' historical trajectory. The institutional climate, permissiveness and low levels of law enforcement, contributed to the siting of polluting activities and the poor on the area. Moreover, in a context of adverse economic conditions, self-reinforcing mechanisms were activated to protect the industrial base of the partido. In a common strategy local government and firms operated together to keep the existing industries and to promote the siting of new facilities over time. At the same time, land invasion and the consolidation of squatter settlements occurred with the compliance of the local government.

Both cases are consistent with the socio-economic argument within the environmental justice literature, which states that residents' strategies regarding environmental pollution differ according to their socio-economic characteristics (Bullard 1992; Pulido 2000). Middle class groups were able to reject polluting activities given their economic resources, organizational capacity, social network, access to the media, etc. All these resources contributed to achieve law enforcement, certain health benefits, the displacement of certain type of polluting industrial production, and to the reduction of polluting activities in the neighborhood. While middle-class resources contributed to distance these groups from pollution, the poor needs explain their exposure to polluting facilities. However, Barracas al Sur shows that the poor needs are not necessarily related to employment opportunities provided by these facilities, but rather with the opportunity to access to the informal labor market (i.e. recycling) given the proximity to the city of Buenos Aires. Moreover, the most pressure need for the poor population is related to the access to land and housing. In this regard degraded public land nearby polluting facilities in Barracas al Sur represents an opportunity to access to the informal land market.

It is important to mention that although in Munro there was an increasing social awareness of the environmental and health-related problems of industrial pollution among middle class neighborhoods, only a few local groups and networks were actively involved in campaigning against polluting industries, that is, environmental claims were not shared by all residents. Here, the environmental blackmail argument (Bullard 1992), which states that residents out of need for local sources of employment accept polluting sites and, hence, to be exposed to pollution, holds for blue-collar residents that work at those facilities.

This growth of environmental awareness, public concern about health risks and other impacts associated with pollution, also contributed the growth of public opposition to environmental pollution in the AMBA in general, and specifically in the Riachuelo

Basin where Barracas al Sur is located. In Barracas al Sur, unlike Munro were residents directly engage in collective action against pollution, these concerns were mainly rise by some environmental NGOs and residents from other neighborhoods, but not necessarily for the most affected residents of neighborhood. Here, environmental pollution of the neighborhood is framed within the broader context of the Riachuelo Basin by different NGOs and the judiciary, and do not address specific polluting facilities as in the case of Munro. This makes it more difficult to focal us specific target actions to reduce the presence of polluting sources located in the neighborhood

Barracas al Sur also shows that the poor's collective action differed from middle class groups. The poor have an important organizational capacity around their more pressing needs linked to access to land, titling regularization, access to housing and services. They struggled to get formal access to urban land and housing markets, and for this reason public vacant land with high levels of pollution and near to the city's core, represented an opportunity to build their squatter settlements. This indicates that the poor limited economic and political resources constrain them to live in polluted and unhealthy areas that for them represent the access to the city.

Despite their differences, these two neighborhoods constitute the back yard of these partidos. Municipalities do not actively address environmental issues; they only react when environmental issues reach the courts. In Munro, despite the social pressure, environmental issues did not capture the attention of local politicians and did not directly influence the local environmental agenda. The same occurs in Barracas al Sur where at the local government level the relevance of the environmental issues is recognized by public officials, but does not form part of their substantive agenda – at least no specific actions have been taken in this regard yet.

Local governments have competence in determine zoning regulations, urban planning and economic development, these are important tools to shape the relationship between population and polluting sources. The analysis of the case studies shows that there is a strong inertia in terms of local government practices. Planning and land-use assignation represents one of the main regulatory tools for the local governments to address the spatial coincidence of LULUs and population; however local land-uses regulations tend to follow the historical spatial distribution characterized by mixed uses (industrial and residential). Both cases illustrated that when land uses are assigned is very unlikely that they will be changed dramatically, especially when industrial activities represent an important source of revenue for local governments as in the case of Barracas al Sur. Munro shows that changes in the land use regulations contribute to lessen the concentration of polluting facilities on the long run, but they take place only when alternative economic developments are possible, and do not respond to environmental concerns. In this regard, economic forces seem to determine local governments' actions that induced continuity or changes in the neighborhoods trajectories. These forces indirectly contribute to either lessen the concentration level of polluting industries or increasing and promoting the concentration of industries and poor population around them. Munro clearly shows that under economic constrains the concentration of polluting industries can remain stable or can be reduce in the search for an alternative economic model. The opposite occurred in the Barracas al Sur where economic constrains and the lack of alternative economic development led to an increased in the concentration of polluting activities.

In sum, the historical spatial pattern of Buenos Aires, as in many Latin American cities was developed through a juxtaposition of industrial areas and working-class neighborhoods. This urban fabric is more socially integrated, that is less segregated than in the American cities. It is for this reason that environmental inequalities regarding industrial pollution are not as marked as it can be found in other contexts. This is not to say that the poor do not face high level negative environmental externalities, but that poverty does not determine the spatial concentration of polluting industries at the metropolitan scale. Another important finding of this study is that, environmental inequalities tend to increase over time. The case studies suggest that there is a reduction on the level of polluting activities in the middle-class neighborhood, while increasing in the poor neighborhood. Three main reasons seem to explain this: i) the economic constrains and opportunities to the local economy determine the permanence of polluting activities in the neighborhoods; ii) the middle-class reactions and engagement in fighting pollution contribute to the reduction of polluting levels in the long run; and iii), local politics and clientelistic practices increase the exposure of the poor to negative environmental externalities over time. The lack of alternatives and resources to access the formal market make the poor face tremendous environmental burdens and trapped them in a noxious environment.

POLICY IMPLICATIONS

Several important policy implications can be derived from the findings of this research. The study shows that areas with high concentration of polluting industries constitute the backyard of the partidos. These areas do not represent a priority on the local agenda. Issues of environmental pollution are not been addressed directly from local governments; instead local governments react to the pressure imposed by the judiciary courts. Law enforcement mechanisms are only activated by residents' demands. From these findings several important policy implications can be derived.

- *Planning (Update Land Use)* Planning is critical toward identifying managing and mitigating risk to the community. Local zoning ordinances that established mixed of land uses containing hazardous facilities impose a significant risk of exposure to the population living nearby. In this regard, planning regulations have paid little or no attention to the negative effects of pollution, and there is an urgent need to implement measures to mitigate these effects. Better land use regulation can reduce these hazards. The current land use regulations are soft or outdated; in this regard local governments should promote a revision of the current zoning ordinances ensuring public participation in the decision making process. In establishing zoning ordinances, local governments must weigh and balance not only the need for housing and development, but also environmental responsibilities. Furthermore, land use decisions should take into account the possible adverse health impacts on nearby residents and vulnerable population.

- *Public Participation & Equal Law Enforcement.* The study shows that law enforcement is achieved by social pressure. Middle class residents alerted to possible dangers caused by hazardous facilities demanded for public intervention. This has twofold implications; on one hand that citizens' participation can contribute to law enforcement and on the other that the poor face unequal levels of law enforcement. In a scenario where public agencies lack of accountability, it is important to promote public participation to enforce the current legislation. To overcome inequalities, it is necessary to guarantee equality in terms of law enforcement and implementation of regulations and policies. Furthermore, it also important to increased public participation by low-income residents in governmental decision-making.

- *Targeted Policies.* This research shows that the poor are exposed to high levels of pollution from industrial sources. The poor are more vulnerable to suffer the consequences of exposure to hazards, because they are more sensitive to impacts due to their limited ability of resources to cope with pollutions' effects. Public polices need to be implemented to improve environmental quality in general, but also is necessary to put into practice target policies and resources to assist poor neighborhoods where residents are most at risk. Moreover, poor neighborhoods exposed to environmental hazards should be granted additional protections to prevent the effects of pollution. These policies may include: conducting additional study of hazardous activities located in the area; providing incentives to preventive behavior; and implement measures such as inhibit the use of substances suspected of causing health damages.

- *Lessen Pollution*. The study shows that the presence of hazardous industrial facilities is all over the area, and that some facilities cause pollution. Preventing pollution should be a major concern because of contamination's harmful effects on the person's health and on the environment in general. For these reasons is necessary to implement preventive measures to reduce current levels of pollution at the sources. Policies should address existing sources of pollution by offering technical assistance to diminish the use of toxic chemicals and promote alternative forms of clean production.

- *Access to Information & Transparency.* Limitations of access to information, transparency, and environmental law enforcement are behind the case studies. This contributed to an increase in environmental inequalities. These factors are essential to warrant common standards and equity across the city. Access to information and data availability represents a major limitation to making informed decisions to policy makers and the population in general. In this regard, it is necessary to collect and provide reliable data that include all kind of sources of pollution and make that information more readily available for communities, local governments and scientists. Citizen's direct access to information on emissions from hazardous facilities will help them to engage actively in decisions affecting their quality of life. Furthermore, this will contribute to hold the firms accountable of their emissions.

Environmental problems call for active state intervention to improve population's quality of life and prevent the negative effects of pollution. Furthermore, state intervention needs to implement policies to re-address environmental inequalities no perpetuating it.

FUTURE RESEARCH DIRECTIONS

Maybe one of the most important contributions of this research is that it opens up a number of questions and issues that provide a rich research agenda for the future. I would like to mention three possible areas of future research that could offer a deeper understanding of environmental inequalities and also address the issue of environmental vulnerability.

One of the case studies findings was that middle-class residents tend to be more reactive to environmental pollution. As a consequence of their pressure firms relocate polluting activities outside their neighborhoods boundaries. However, that the fact that middle-class reaction increases environmental inequalities need further analysis. New studies would be needed to measure effectively the impact of collective action in urban inequality. Moreover, in order to explore the hypothesis that the displacement of polluting activities exacerbates inequalities, it would be useful to identify if these activities relocate in poor neighborhoods and the reasons that drive the new siting decision. In this regard, longitudinal studies of the metropolitan area could help to detect changes in the levels of inequality.

Another aspect that needs further exploration is the effects of industrial concentration on segregation. These effects may go both ways. If segregation is related to the quality of the urban environment, that is areas with low environmental quality attracted the poor (as the case study suggests) segregation patterns would increase. On the other hand, if middle class residents put significant value on the environmental quality this may prevent them to locate in polluting areas, increasing segregation. Studies conducted at the metropolitan region or state level would provide a better idea of approximation for identifying these effects.

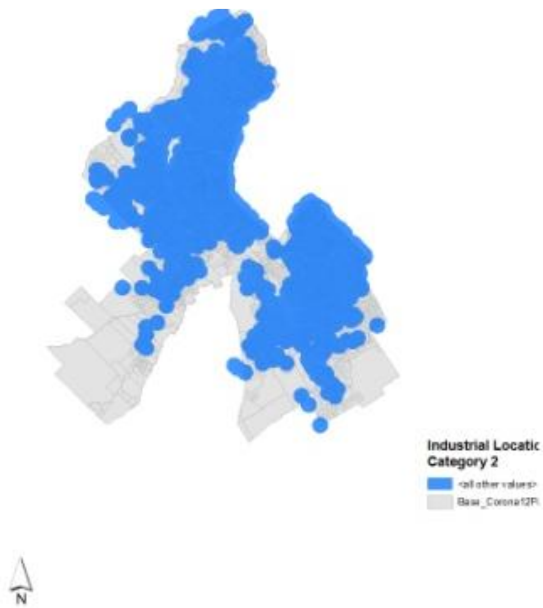
Finally, this study focused on environmental inequalities regarding polluting industries. However, environmental threats are not limited to industrial pollution but also may include landfills and illegal landfills, contaminated ground water, floods and natural hazards among others. Future studies should focus on the analysis of environmental threats and specifically in how they affect the poor. In so doing, these studies should generate reliable data on environmental variables to take into account the total environmental burden and related health impacts upon residents. This index could help to identify the threats to which population and the poor are exposed, the health effects of pollution and the urban inequalities. The special focus on the poor is needed because even though pollution affects all social classes, the poor are extremely vulnerable to suffer the consequences of pollution. This is an ambitious research agenda due to the type of data needed, especially in Argentina, where, at this time data on environmental variables is almost non-existent.

APPENDICES

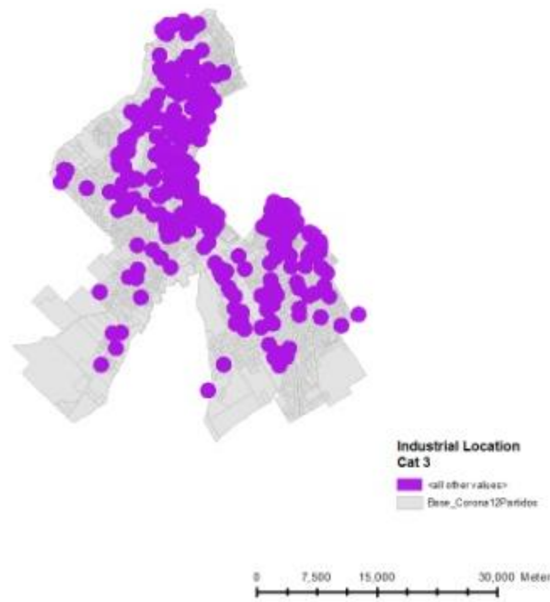
APPENDIX 1. MAPS

Map 4.4. Spatial Distribution of Industrial Buffers

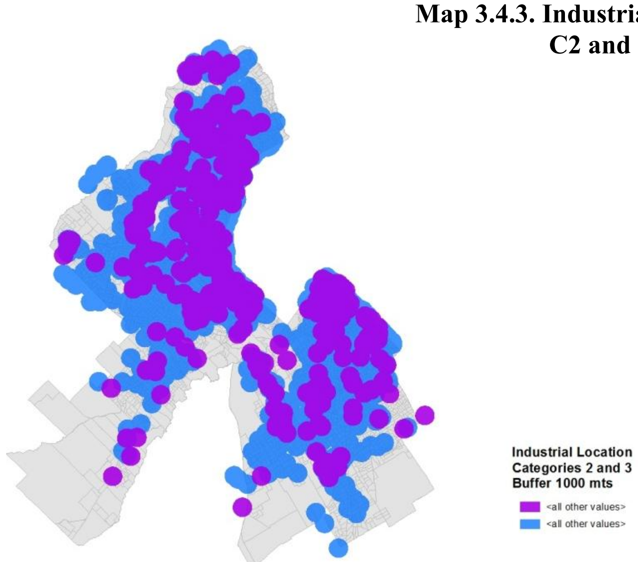
Map 3.4.1. Industrial buffers - C2



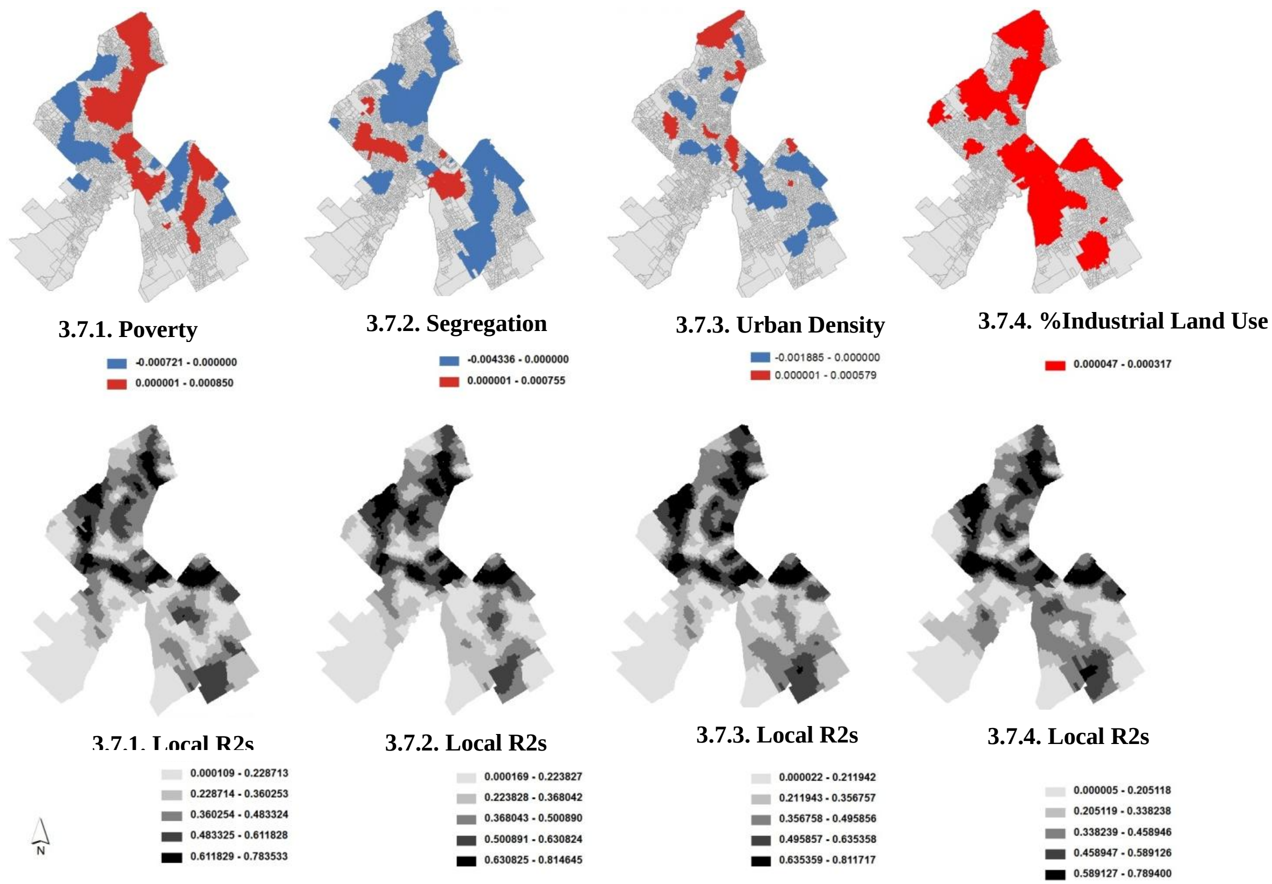
Map 3.4.2. Industrial buffers C3



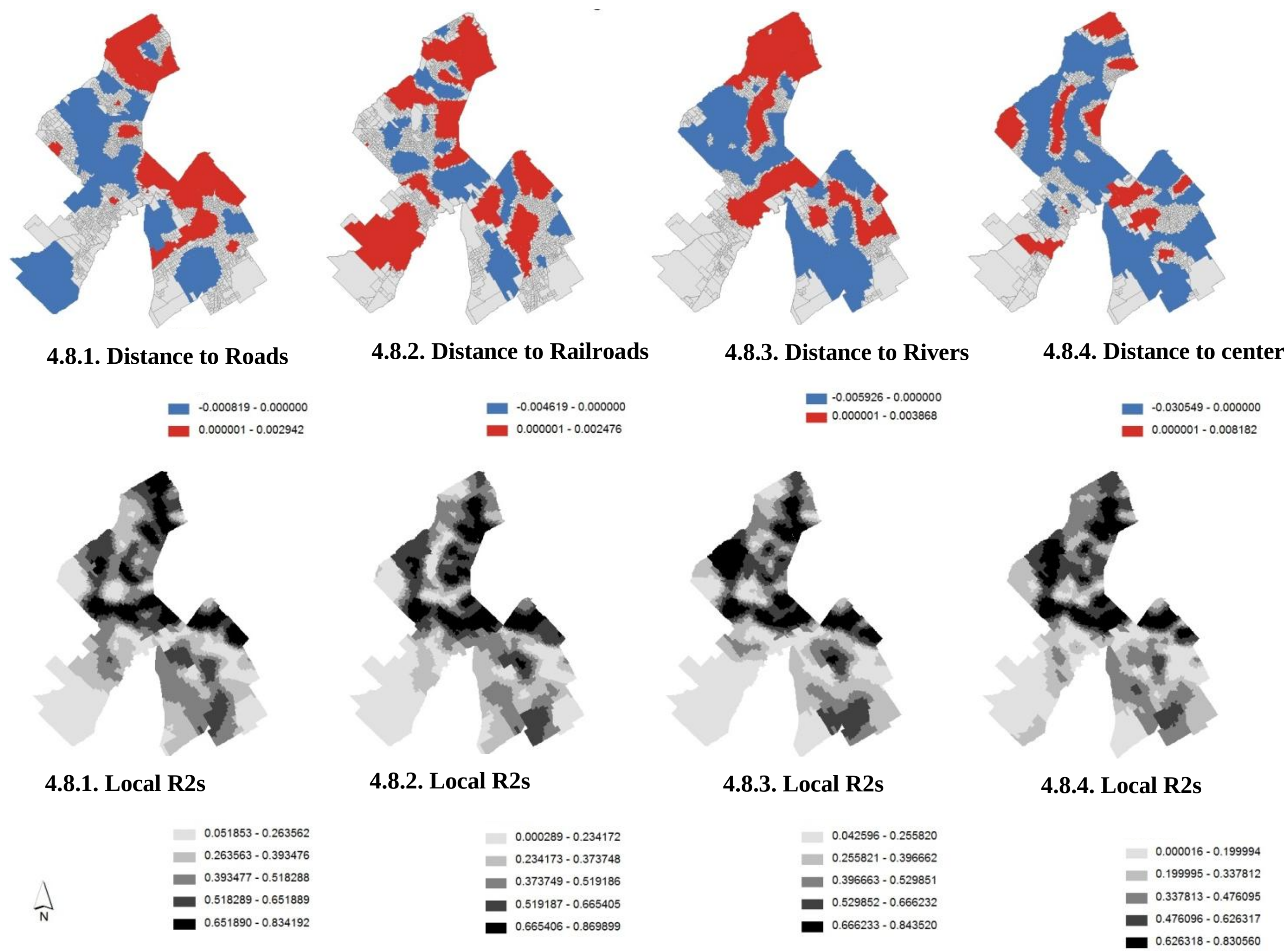
Map 3.4.3. Industrial buffers overlapped C2 and C3 industries



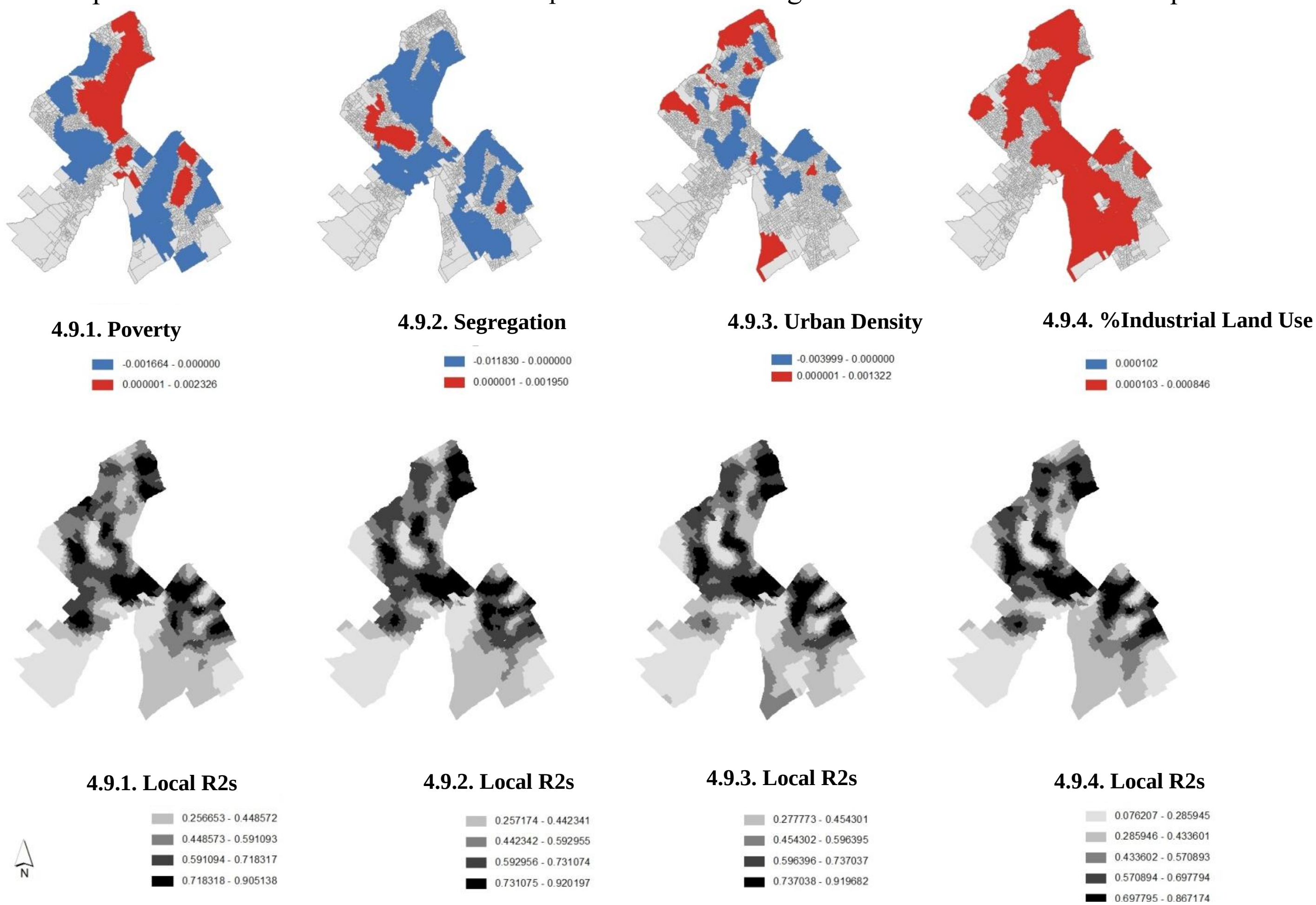
Map 4.7. Univariate Model1 DC3 Independent Variables: Significant values and Local R-Squared



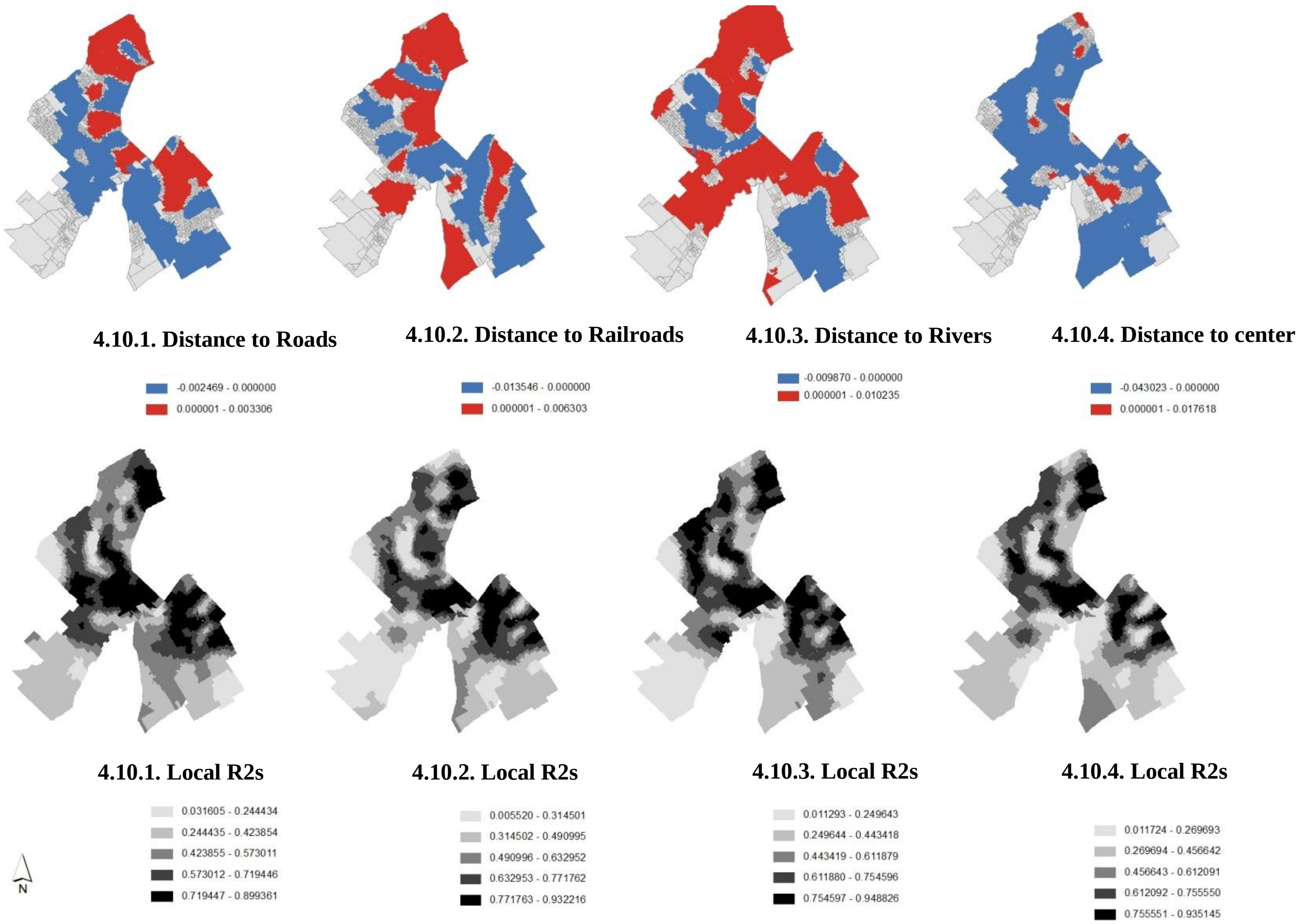
Map 4.8. Univariate Model1 DC3 Independent Variables: Significant Values and Local R-Squared



Map 4.9. Univariate Model2 DC2&3 Independent Variables: Significant Values and Local R-Squared

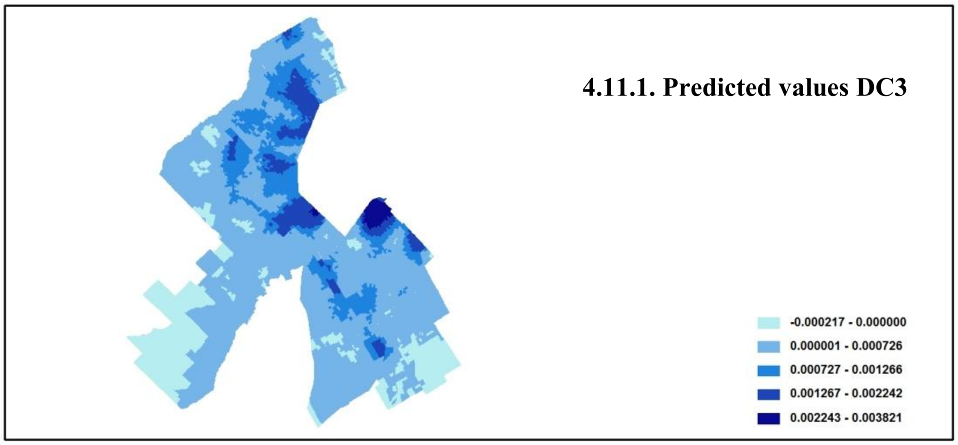


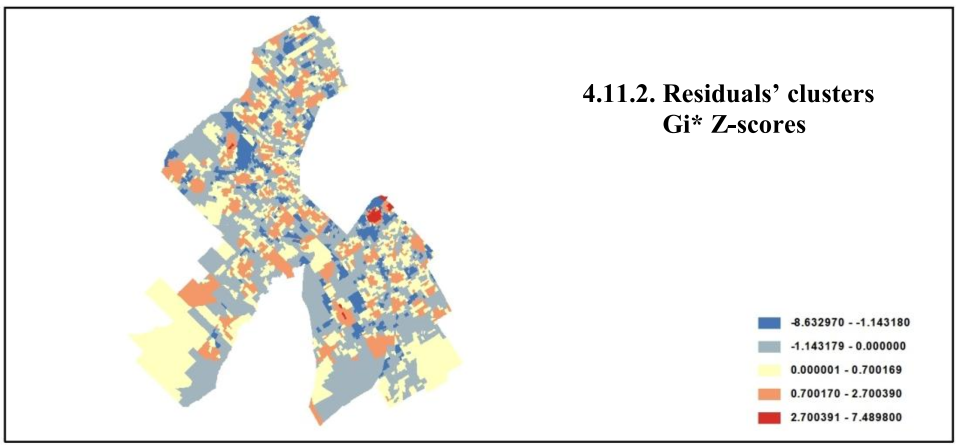
Map 4.10. Univariate Model2 DC2&3 Independent Variables: Significant Values and Local R-Squared

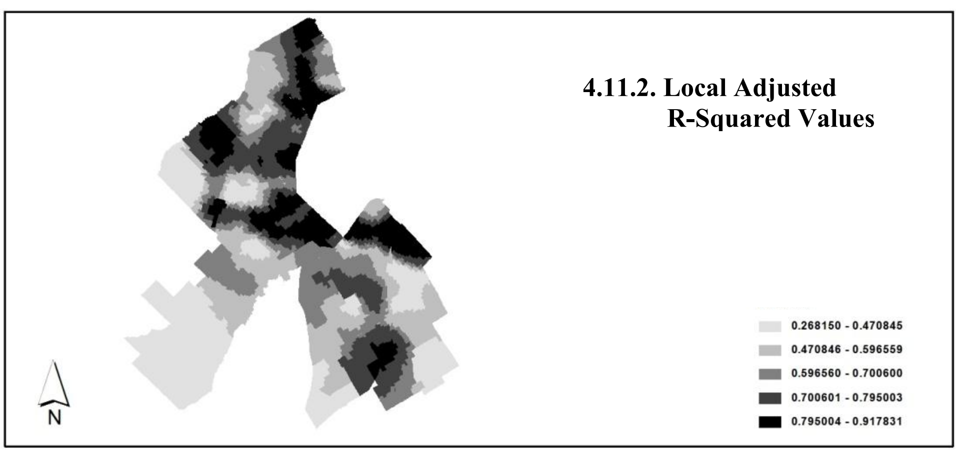


Map 4.11. Multivariate Model1 DC3 Results:

Predicted values, Residuals clusters and Local R-Squared

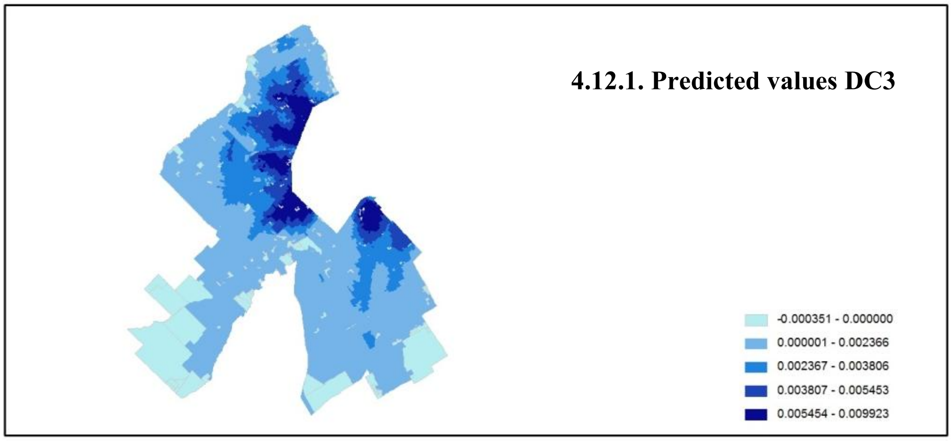


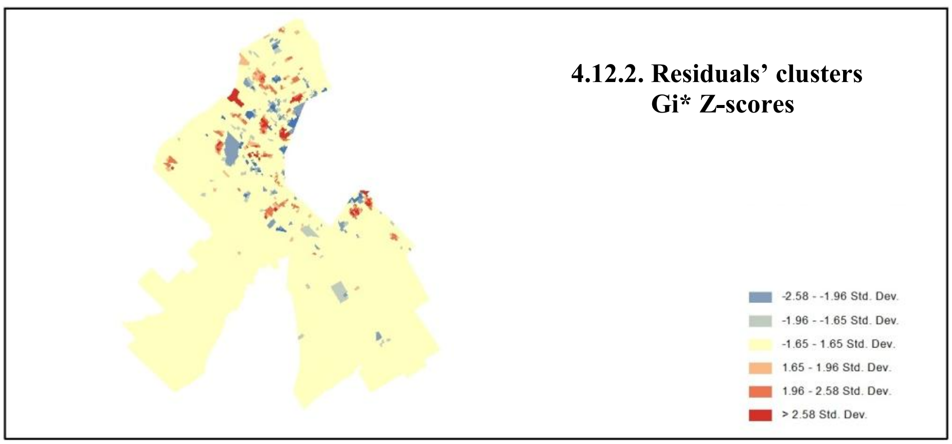


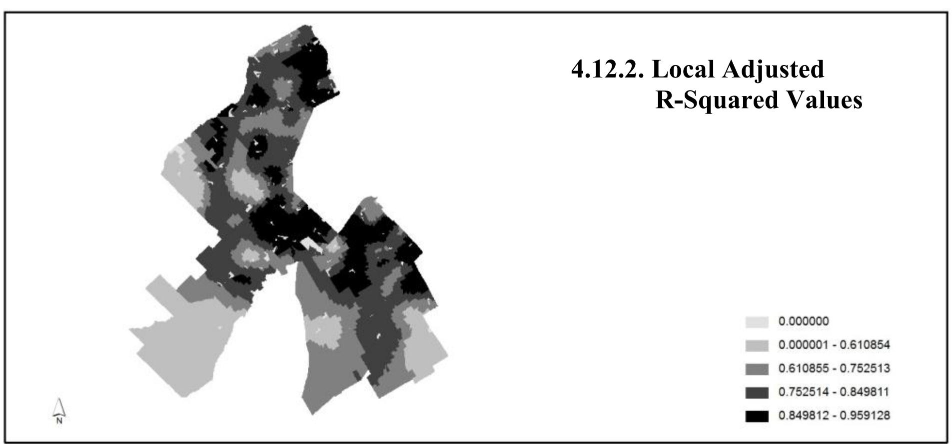


Map 4.12. Multivariate Model2 Results DC2&3:

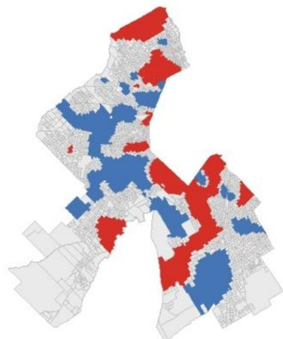
Predicted values, Residuals clusters and Local R-Squared



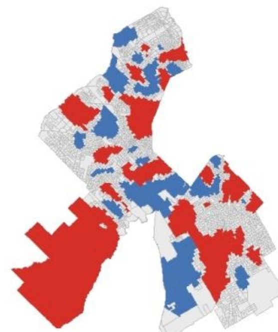




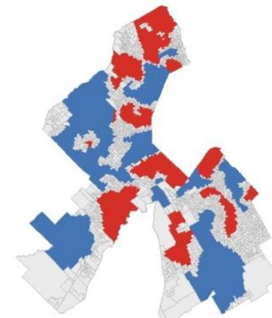
Map 4.17. Multivariate Model1 Results DC3: Independent Variables



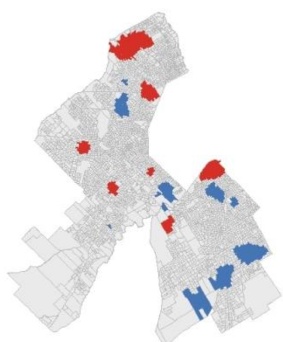
4.17.1. Distance to Roads



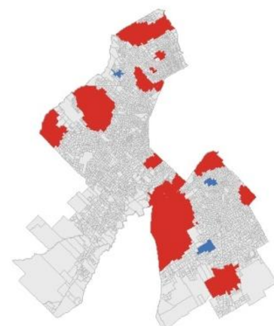
4.17.2. Distance to Railroads



4.17.3. Distance to Rivers

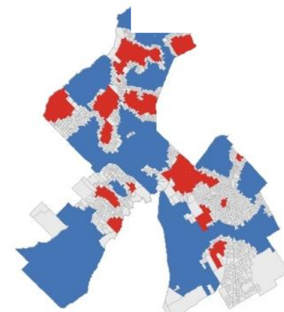


4.17.4. Urban Density

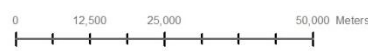


4.17.5. %Industrial Land Use

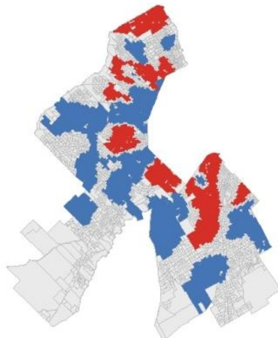
4.9.4. Local R2s



4.17.6. Segregation Distance to Center

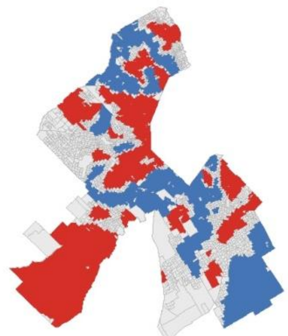


Map 4.18. Multivariate Model2 Results DC2&3: Independent Variables



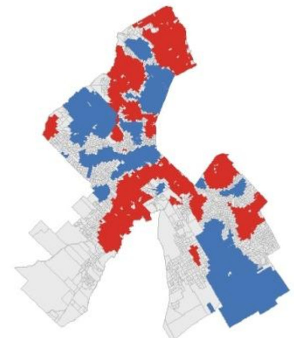
4.18.1. Distance to Roads

-0.001867 - 0.000000
0.000001 - 0.007641



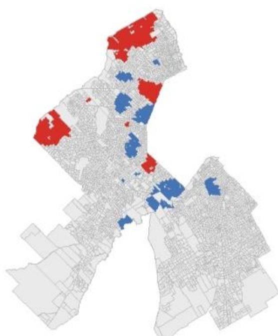
4.18.2. Distance to Railroads

-0.015702 - 0.000000
0.000001 - 0.014842



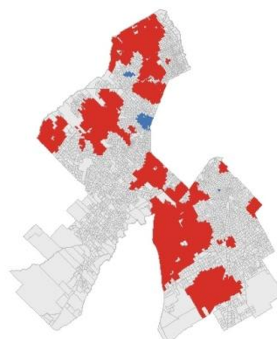
4.18.3. Distance to Rivers

-0.041677 - 0.000000
0.000001 - 0.034856



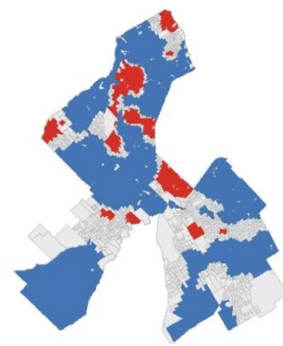
4.18.4. Urban Density

-0.001519 - 0.000000
0.000001 - 0.001183



4.18.5. %Industrial Land Use

-0.000174 - 0.000000
0.000001 - 0.000355



4.18.6. Distance to Center

-0.151255 - 0.000000
0.000001 - 0.123194

N

0 6,000 12,000 24,000 Meters

APPENDIX 2.

CORRELATION MATRIX

Table 4.2. Correlation Matrix

	DC3	DC2&3	Poverty	Industrial Land-Use	Roads	Railroads	Rivers	Segregation	Urban Density	Distance to Center
DC3	1.0000									
DC2&3	0.7851	1.0000								
Poverty	-0.1500	-0.3469	1.0000							
Industrial Land-Use	0.2672	0.2574	0.0073	1.0000						
Roads	0.2116	0.0925	0.2159	-0.0075	1.0000					
Railroads	0.9000	-0.0278	0.4477	0.0440	0.2900	1.0000				
Rivers	0.1731	0.4815	-0.2599	0.0848	-0.0098	-0.0074	1.0000			
Segregation	-0.1137	-0.1946	0.2466	-0.0793	0.1361	0.0889	-0.1891	1.0000		
Urban Density	0.1332	0.1900	-0.0357	-0.1940	0.1077	0.0325	0.1377	-0.0330	1.0000	
Distance to Center	-0.5386	-0.7151	0.4400	-0.1300	-0.1028	0.032	-0.3404	0.1093	-0.3767	1.0000

ANOVA TEST

Table 4.6. ANOVA test

	Model 1			
	Facilities C 3			
Source	SS	DF	MS	F
OLS Residuals	0.0	9.00		
GWR Improvement	0.0	334.49	0.0	
GWR Residuals	0.0	4362.51	0.0	41.2231

	Model 2			
	Facilities C 2 and 3			
Source	SS	DF	MS	F
OLS Residuals	0.0	9.00		
GWR Improvement	0.0	338.06	0.0	
GWR Residuals	0.0	4446.94	0.0	69.81

APPENDIX 3. FORMULAS

Fotheringham's adjustment

$$\beta = \frac{\alpha}{1 + Pe - \frac{Pe}{Np}}$$

α=	Unadjusted test level 0.05
n=	Regression points
Pe=	Parameters estimated (including the intercept)
np=	Degrees of freedom

BIBLIOGRAPHY

2004. "Munro:Vecinos exigen el cierre de Atanor " in *El Comercio Online*.

2007. "Munro cromado." in *Página 12*. Buenos Aires.

2008. "No será agua perfecta, pero es potable." in *InfoBan*. Buenos Aires.

Agency for toxic substance and diseases registry, ATDSR. 2005. "Chapter 6: Exposure evaluation." U.S. Department of Health and Human Services Public Health Service Atlanta, Georgia.

Anselin, L and DA Griffith. 1988. "Do spatial effects really matter in regression analysis?" *Papers in Regional Science* 65:11–34.

Anselin, Luc. 1988. *Spatial econometrics: methods and models*. Dordrecht, Netherlands: Kluwer Academic Publishers.

—. 1992. "Spatial data analysis with GIS: an introduction to application in the social sciences." Pp. 10–92. Santa Barbara: National Center for Geographic Information and Analysis.

Arauzo Carod, Josep María. 2004. "Determinants of industrial location: An application for Catalan municipalities." Oxford. UK.: Blackwell Publishing.

Auyero, Javier and Debora Swistun. 2007. "The social production of toxic uncertainty." http://ceas.iscte.pt/ethnografeast/papers/javier_auyero.pdf.

Auyero, Javier. and Débora Alejandra Swistun. 2008. *Inflamable : estudio del sufrimiento ambiental*. Buenos Aires: Paidós.

Baden, Brett and Don Coursey. 2002. "The locality of wastes sites within the city of Chicago: A demographic, social and economic analysis." *Resource and Energy Economics* 24:53-93.

Barrow Christopher. 2005. *Environmental management and development*. New York: Routledge: Taylor & Francis Group.

Bartone, Carl R. 2001. "Urban environmental management and the poor. Environmental strategy background paper."

Been, V. and F. Gupta. 1997. "Coming to the nuisance or going to the barrios? A longitudinal analysis of environmental justice claims." *Ecology Law Quarterly* 24:1-56.

Been, Victoria. 1994. "Locally undesirable land uses in minority neighborhoods - Disproportionate siting or markets dynamics." *Yale Law Journal* 103:1383-1422.

Bennett, Andrew and Colin Elman. 2006. "Complex causal relations and case study methods: The example of path dependence." *Political Analysis* 14:250-267.

Bistagnino, Paula. 2003. "Argentina: crónica de un barrio envenenado: detectan pesticidas en torno a una planta fabril, en Carapachay " in *Pagina 12*. Buenos Aires.

Blacksmith Institute. 2007, "The World's Worst Polluted Places. The top ten (of the dirty thirty)", Retrieved

Blair, John and Robert Permus. 1987. "Major factors in industrial location: a review." *Economic Development Quarterly* 1:72-85.

Bohon, Stephanie A. and Craig R. Humphrey. 2000. "Courting LULUs: Characteristics of suitor and objector communities." *Rural Sociology* 65:376-395.

Bolin, Bob, Amy Nelson, and Edward J Hackett. 2002. "The ecology of technological risk in a Sunbelt city." *Environment and Planning A* 34:317 - 339.

Boone, Christopher and Ali Modarres. 1999. "Creating a toxic neighborhood in Los Angeles County: A historical examination of environmental Inequity." *Urban Affairs Review* 35:163-187.

Boschman, R and J Lambooy. 1999. "Evolutionary economics and economic geography." *Evolutionary Economics* 9:411-429.

Bozzano, Horacio. 1999. "Les territoires de la restructuration industrielle dans la region metropolitaine de Buenos Aires." Geographie Amenagement Urbanisme, Universite de la Sorbonne Nouvelle- Paris III, Paris.

—. 2000. "Atractividad territorial y cementerios industriales. Fortalezas y debilidades de la reestructuración industrial en la Región Metropolitana de Buenos Aires." *Polígonos* 10:137-153.

Brunsdon, Chris. 1999. "Some notes on parametric significance tests for geographically weighted regression." *Journal of Regional Science* 39:497-524.

Brunsdon, Chris, Steward Frotheringham, and Martin Charlon. 1998. "Geographically weighted regression-modelling spatial non-Stationarity." *Journal of the Royal Statistical Society, Series D (The Statistician)* 47:431-443.

Bullard, Robert. 1983. "Solid waste sites and the black Houston community." *Social Inquiry* 53:82-95.

—. 1990. *Dumping in Dixie: Race class and environmental quality*. Boulder, Colorado: Westview Press.

—. 1992. "Environmental blackmail in minorities communities." in *Race and the incidence of environmental hazards: A time for discourse.*, edited by B. Bryant and P. Mohai. Boulder, CO.: Westview Press.

Byrne, Graeme, Martin Charlton, and Stewart Fotheringham. 2009. "Multiple Dependent Hypothesis Tests in Geographically Weighted Regression." in *10th International Conference on GeoComputation*. Sydney, Australia: www.biodiverse.unsw.edu.au/geocomputation/.../Byrne_et_al.pdf

Can, Ayse. 1992. "Specification and estimation of hedonic housing price models." *Regional science and urban economics* 22:453-474.

Charlon, Martin, Stewart Fotheringham, and Chris Brunsdon. 2010. "Geographically weighted regression workbook." University of California, Santa Barbara, GWR workshop at Santa Barbara.

Clichevsky, Nora. 2002. "Pobreza y políticas urbano-ambientales en Argentina." Naciones Unidas, Santiago.

Collier, David and James Mahoney. 1996. "Insights and pitfalls: Selection bias in qualitative research." *World Politics* 49:56-91.

Cravino, María Cristina. 2008. "Magnitud y crecimiento de las villas y asentamientos en el Área Metropolitana de Buenos Aires en los últimos 25 años." Pp. 1-17 in *Encuentro de la Red ULACAV (XIV, 2008,). Facultad de Arquitectura, Universidad Nacional de Buenos Aires*. Buenos Aires, Argentina: Instituto del Conurbano, Universidad Nacional de General Sarmiento.

Defensor del Pueblo de La Nación. 2003a. "Informe Especial sobre la Cuenca Matanza Riachuelo." Buenos Aires.

Defensor del Pueblo de la Nación. 2003b. "Matanza - Riachuelo: la cuenca en crisis." Defensor del Pueblo de la Nación - Ombudsman Nacional, Buenos Aires.

Department of Economic and Social Affairs of the United Nations. 2004. "World urbanization prospects: The 2003 revision."

Dirección de Planeamiento de Lanús. 2009. "Lineamientos Lanus. Draft." Municipalidad de Lanus, Lanus.

Direccion de Vivienda de la Municipalidad de Lanús. 1984. "Informe Técnico socio-ambiental. Investigación Social: Barrio Eva Perón." Secretaría de Bienestar Social de la Provincia de Buenos Aire, Lanus.

Downey, Liam. 2006. "Environmental racial inequality in Detroit." *Social Forces* 85:771-196.

Facciolo, Ana María. 1981. "Crecimiento industrial, expansión metropolitana y calidad de vida." *Desarrollo Económico* 20:549-568.

Flores, Carolina. 2008. "Residential segregation and the geography of opportunities:a spatial analysis of heterogeneity and spill overs in education." LBJ School of Public Affairs, University of Texas at Austin, Austin.

Flores, Carolina and Robert Wilson. 2009. "Changing patterns of residential segregation in Austin." in *Urban segregation and governance in the Americas*, edited by B. Roberts and R. Wilson. New York: Palgrave Macmillan.

Forsyth, Tim, Melisa Leach, and Ian Scoones. 1998. "Poverty and environment: priorities for research and policy. An overview." Institute of Development Studies, Falmer, Sussex, UK.

Fotheringham, Steward and Chris Brunsdon. 1998. "Geographically weighted regression: a natural evolution of the expansion methods for spatial data analysis." *Environment and Planning A* 30:1905-1927.

Fotheringham, Steward, Chris Brunsdon, and Martin Charlton. 2000. *Quantitative geography. Perspectives on spatial data analysis*. Trowbridge: SAGE Publications.

—. 2002. *Geographically weighted regression the analysis of spatially varying relationships*. Chichester, England: John Wiley & Sons, LTD.

Fotheringham, Stewart. 2010. "Multiple Hypothesis Testing : Setting critical values for local pseudo-t statistics. Lecture N^{o} 9." in *GWR Workshop*. University of California, Santa Barbara.

Fricker, Ronald. 2001. "Environmental equity and the distribution of toxic release inventory and other undesirable sites in metropolitan New York City." *Environmental and Ecological Statistics* 8:33-52.

Fritzsche, Federico and Marcela Vio. 2002. "Cambios y enroques en las pautas de localización industrial en la Región Metropolitana de Buenos Aires. Sus efectos sobre las PYMES." in *Presentado en la VIIta Reunión Anual de la Red PyMEs-MERCOSUR*. Rafaela.

—. 2005. "La huella del desarrollo urbano en la Región Metropolitana de Buenos Aires. Consideraciones acerca de las transformaciones recientes del espacio industrial." *Scripta Nova. Revista electrónica de geografía y ciencias sociales*.

Fundación Ciudad. 2002. "Foro Desarrollo Sostenible de la Cuenca Matanza Riachuelo. Guía de Trabajo." Fundación Ciudad, Buenos Aires.

George, Alexander and Andrew Bennett. 2005. *Case studies and theory development in the social sciences*, Edited by H. U. JFK School of Government. Cambridge, Massachusetts: MIT Press.

Geschwind, Sandra and et al. 1992. "Risk of congenital malformations associated with proximity to hazardous waste sites." *American Journal of Epidemiology* 11:1197-1207.

Gilbert, Alan. 1996. "Latin America mega-city: An introduction." Pp. 1-24 in *The megacity in Latin America*, edited by A. Gilbert. Tokyo: United Nations University Press.

—. 1997. *La ciudad Latino Americana*. México DF: Siglo XXI.

Gilbert, Alan and Peter Ward. 1988. "Land for the rich, land for the poor." Pp. 129-137 in *Urbanization of the Third World*, edited by J. Gugler. Oxford: Oxford University Press.

Goodchild, Michael and Donald Janelle. 2004. "Spatially integrated social science." in *Spatial Information System*. New York: Oxford University Press.

Graso, Francisco. 1953. *Historia de la ciudad de Vicente López*. Vicente Lopez: C. amigos de las letras y las artes y las ciencias.

Greene, Jennifer. 2008. "Is mixed methods social inquiry a distinctive methodology?" *Journal of Mixed Methods Research* 2.

Groisman, Fernando and Ana Lourdes Suárez. 2009. "Residential segregation in Greater Buenos Aires." in *Urban segregation and governance in the Americas*, edited by B. Roberts and R. Wilson. New York: Palgrave Macmillan.

Gutman, Margarita and Jorge Hardoy. 2006. *Buenos Aires 1536-2006. Historia urbana del Area Metropolitana*. Buenos Aires: Ediciones Infinito.

Hamilton, James. 1993. "Politics and social costs: estimating the impact of collective action on hazardous waste facilities." *RAND Journal of Economics* 24.

—. 1995. "Testing for environmental racism: Prejudice, profits, political Power?" *Journal of Policy Analysis and Management* 14:107-132.

Hardoy, Jorge, Diana Mitlin, and David Satterthwaite. 1992. *Environmental problems in third world cities*. London: Earthscan Publications Limited.

Hardoy, Jorge and David Satterthwaite. 1997. "Building the future city." in *Cities in the developing world. Issues, theory and policy*, edited by J. Gugler. New York: Oxford University Press Inc.

Holifield, Ryan. 2001. "Defining environmental justice and environmental racism." *Urban Geography* 22:78-90.

Inter-American Development Bank. 2007. "Urban environment and pollution control."

International Development Research Center. 2005. "Urban poverty and environment. Prospectus 2005-2010."

Irabelli, Cristina. 1997. *El barrio de Munro*. Munro: Museo Dinámico.

Janoschka, Michael. 2002. "El nuevo modelo de la ciudad latinoamericana: fragmentación y privatización." *EURE* 28:11-20.

Jorge, F Eduardo. 1971. *Industria y concentración económica. Desde principios de siglo hasta el peronismo.* Buenos Aires: Siglo XXI Argentina Editores, S. A.

Kjellstrom, Tord, Sharon Friel, Jane Dixon, Carlos Corvalan, Eva Rehfuess, Diarmid Campbell-Lendrum, Fiona Gore, and Jamie Bartram. 2007. "Urban environmental health hazards and health equity." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 84.

Kreig, Eric. 1995. "A socio-historical Interpretation of toxic waste sites: The case of Greater Boston." *American Journal of Economics and Sociology* 54:1-14.

—. 1998. "The two faces of toxic waste: Trends in the spread of environmental hazards." *Sociological Forum* 13:3-20.

Kreig, Eric and Daniel Faber. 2004. "Not so Black and White: environmental justice and cumulative impact assessments." *Environmental Impact Assessment Review* 24:667–694.

Krugman, Paul. 1991. "History and Industry location: The case of the Manufacturing Belt." *The American Economic Review* 81:80-83.

Lambert, Thomas and Charles Boerner. 1997. "Environmental inequity: Economic causes, economic solutions." *Yale Journal on Regulation*.

Lanzetta, Máximo and Néstor Spósito. 2003. "Proceso Apell Dock Sud." Buenos Aires: PAI/CIPRA/GTZ. Not published.

Lee, Charles. 2002. "Environmental justice: Building a unified vision of health and the environment." *Environmental Health Perspectives* Vol. 110, Supplement 2:141-144.

Lejano, Raul, Bill Piazza, and Douglas Houston. 2002. "Rationality as social justice and the spatial-distributional
analysis of risk." *Environment and Planning C: Government and Policy* 20:871-888.

Lejano, Raul and Scott Smith. 2006. "Incompatible lad uses and the topology of cumulative risk." *Environmental Management* 37:230-246.

Lineberry, Robert. 1977. *Equality and urban policy*, vol. 39. Beverly Hills: Sage.

Longley, Paul A. and Carolina Tobón. 2005. "Spatial dependence and heterogeneity in patterns of hardship: An intra-urban analysis." *Annals of the Association of American Geographers* 94:503-519.

Longley, Paul, Michael Goodchild, David Maguire, and David Rhind. 2005. *Geographical information systems and science*. Barcelona: John Wiley & Sons Ltd.

Mahoney, James. 2000. "Path dependence in historical sociology." *Theory and Society* 29:507-548.

—. 2004. "Comparative-historical methodology." *Annual Review of Sociology* 30:81-101.

Mahoney, James and Gary Goertz. 2006. "A tale of two cultures: Contrasting quantitative and qualitative research." *Political Analysis Advance Access* June.

Massey, Douglas and Nancy Denton. 1988. "The dimensions of residential segregation." *Social Forces* 67:281-315.

McMichael, Anthony J. 2000. "The urban environment and health in a world of increasing globalization: issues for developing countries." in *Bulletin of the World Health Organization*: World Health Organization.

Mennis, Jeremy. 2002. "Using geographic information systems to create and analyze statistical surfaces of population and risk for environmental justice analysis." *Social Science Quarterly* 83:281-297.

Mennis, Jeremy and Lisa Jordan. 2005. "The distribution of environmental equity: exploring spatial nonstationary in multivariate models of air toxic release." *Annals of the Association of American Geographers* 95 (2):249-268.

Ministerio del Interior. 1995. "El Conurbano Bonaerense. Relevamiento y Análisis." Buenos Aires.

Mohai, Paul, David Pellow, and J. Timmons Roberts. 2009. "Environmental Justice." *Annual Review of Environment and Resources* 2009:405-430.

Mohai, Paul and Robin Saha. 2006. "Reassessing racial and socioeconomic disparities in environmental justice research." *Demography* 43:383-399.

Morello-Frosch, Rachel, Manuel Pastor, and James Sadd. 2001. "Environmental justice and Southern California's "riskscape": The distribution of air toxics exposures and health risks among diverse communities." *Urban Affairs Review* 36:551-578.

Mosquera, Jose and Luis Calderón. 1995. "La historia de los censos industriales de Argentina 1895-1985." Buenos Aires.

Municipalidad de la Ciudad de Buenos Aires. 1968. "Informe Preliminar. Etapa 1959-1960. Plan Director de la Ciudad de Buenos Aires." edited by Organizacion del Plan Regulador. Buenos Aires.

Nabalamba, Alice. 2001. "Locating risk: a multivariate analysis of the spatial and socio-demographic characteristics of pollution." Planning, University of Waterloo, Ontario.

Needham, Barrie and Erik Louw. 2006. "Institutional economics and policies for changing land markets: the case of industrial states in the Netherlands." *Journal of Property Research* 23:75-90.

Osborne, Patrick E., Giles M. Foody, and Susana Suarez-Seoane. 2007. "Non-stationarity and local approaches to modelling the distributions of wildlife." *Diversity & Distributions* 13:313-323.

Oszlak, Oscar. 1991. *Merecer la ciudad. Los pobres y el derecho al espacio urbano.* Buenos Aires: CEDES/HUMANITAS.

Pastor, Manuel, James Sadd, and Rachel Morello-Frosch. 2004. "Waiting to inhale: the demographics of toxic air release facilities in 21st-century California." *SOCIAL SCIENCE QUARTERLY* 85.

Perlin, S. A., R. W. Setzer, J. Creason, and K. Sexton. 1995. "Distribution of industrial air emissions by income and race in the United States: An approach using the Toxic Release Inventory." *Environmental Science & Technology* 29:69-80.

Peters, Paul and Emily Skolp. 2009. "Urban Governance and Intra-Urban Population Differentials in Latin America: A case study of Metropolitan Lima, Peru." edited by B. Roberts and R. Wilson. New York: Palgrave Macmillan.

Pinto da Cunha, José Marcos and Maren Andrea Jiménez. 2009. "The process of cumulative disadvantage: Concentration of poverty and the quality of public education in the Metropolitan Region of Campinas." in *Urban segregation and governance in the Americas*, edited by B. Roberts and R. Wilson. New York: Palgrave Macmillan.

Pírez, Pedro. 1994. *Buenos Aires Metropolitana Política y gestión de la ciudad*. Lomas del Mirador, Prov. de Buenos Aires: Centro Editor de América Latina S.A.

—. 2006. "La privatización de la expansión metropolitana en Buenos Aires." *Economía, Sociedad y Territorio.* VI:31-54.

Pollock, P. and M. Vittas. 1995. "Who bears the burden of environmental pollution? Race, ethnicity, and environmental equity in Florida." *Social Science Quarterly* 76:294–310.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2012. "World population prospects: The 2010 revision and world urbanization prospects: The 2011 revision."

Pulido, Laura. 1996. "A critical review of the methodology of environmental racism research." *Antipode* 28:142-&.

—. 2000. "Rethinking environmental racism: White privilege and urban development in Southern California." *Annals of the Association of American Geographers* 90:12, 40.

Pulido, Laura, S. Sidawi, and R. O. Vos. 1996. "An archaeology of environmental racism in Los Angeles." *Urban Geography* 17:419-439.

Rapoport, Mario. 2005. *Historia económica, política y social de la Argentina (1880-2003).* Buenos Aires: Planeta/Ariel.

Ryan, Daniel. 2004. "Ciudadanía y Control de Gobierno en la Cuenca Matanza Riachuelo. Informe de Investigación." Austin: Teresa Lozano Institute of Latin American Studies. University of Texas at Austin.

Saha, Robin. 2002. "A longitudinal and historic context analysis of racial and socioeconomic inequities in the distribution of hazardous waste facilities." Natural Resources and Environment, University of Michigan.

Saha, Robin and Paul Mohai. 2005. "Historical context and hazardous waste facility siting: Understanding temporal patterns in Michigan." *Social Problems* 52:618–648.

Satterthwaite, David. 2003. "The links between poverty and the environment in urban areas of Africa, Asia, and Latin America." *The ANNALS of the American Academy of Political and Social Science 2003* 590.

Schvarzer, Jorge. 1996. *La industria que supimos conseguir. Una historia político-social de la industria Argentina.* Buenos Aires: Planeta.

—. 2000. "La implantación industrial." Pp. 209-226 in *Buenos Aires. Historia de cuatro siglos,* vol. 2, edited by J. L. Romero. Buenos Aires: Altamira.

Schweitzer, Lisa and Max Stephenson. 2007. "Right answers, wrong questions: Environmental justice as urban research." *Urban Studies* 44:319–337.

Secretaría de Estado de Transporte y Obras Públicas. 1977. "Estudio Especial del SIMEB. Resultados. Versión Preliminar." Ministerio de Economía, Buenos Aires.

Secretaría del Consejo Nacional de Desarrollo. 1969. "Esquema Director Año 2000." Presidencia de la Nación Argentina, Buenos Aires.

Sheppard, Eric, Helga Leitner, Robert MacMaster, and Hongguo Tian. 1999. "GIS-based measures of environmental equity: Exploring their sensitivity and significance." *Journal of Exposure Analysis and Environmental Epidemiology* 9:18-28.

Smith, David. 1974. "Who gets what where and how: a welfare focus for human geography." *Geography* 59.

Sociedad Central de Arquitectos. 1955. "Desarrollo de Buenos Aires y el Gran Buenos Aires." *Revista de Arquitectura* 375.

Stake, Robert. 1998. "Case studies." in *Strategies of qualitative inquiry*, edited by Denzin and Lincoln: SAGE.

Stephens, Carolyn. 1996. "Healthy cities or unhealthy islands? The health and social implications of urban inequality." *Environment and Urbanization 1996* 8.

Suárez Arocena, Silvia. 2009. "Levantaron la clausura de la química Atanor." *La Nación*.

Suárez, Odilia. 1994. *Planes y códigos para Buenos Aires 1925-1985*. Buenos Aires: Secretaria de Extensión Universitaria y Bienestar Estudiantil y el Centro de Estudiantes de la Facultad de Arquitectura, Diseño y Urbanismo de la Universidad Nacional de Buenos Aires.

Subsecretaría de Urbanismo y Vivienda. 2007. "Lineamientos estratégicos para la Región Metropolitana de Buenos Aires." Dirección Provincial de Ordenamiento Urbano y Territorial, La Plata.

Sweeney, Stuart and Edward Feser. 2004. "Business location and spatial externalities." Pp. 239-262 in *Spatially integrated social science, Spatial information system*, edited by M. Goodchild and J. Donald. New York: Oxford University Press.

Szasz, Andrew and Michael Meuser. 1997. "Environmental inequalities: Literature review and proposals for new directions in research and theory." *Current Sociology* 45:99-120.

—. 2000. "Unintended, inexorable : The production of environmental inequalities in Santa Clara County, California." *American Behavioral Scientist* 43.

Tobler, W. R. 1970. "A Computer Movie Simulating Urban Growth in the Detroit Region." Pp. 234-240 in *Economic Geography*, vol. 46: Clark University.

Torres, Haroldo and Renata Bichir. 2009. "Residential segregation in São Paulo: Consequences for urban policies." in *Urban segregation and governance in* *the Americas*, edited by B. Roberts and R. Wilson. New York: Palgrave Macmillan.

Torres, Horacio. 2006. *El Mapa Social de Buenos Aires (1940-1990)*, Edited by Dirección de Investigaciones. Secretaría de Investigación y Posgrado. Ciudad de Buenos Aires: Ediciones FADU.

United Nations. 2010. "The millennium development goals report. Press release."

United Nations Environmental Program. 2000. "Global environmental outlook 2000."

—. 2007. "Global environmental outlook. GEO-4 report, environment for development."

United Nations Human Settlements Programme. 2003. "The challenge of slums. Global report on human settlements 2003." UN-Habitat, London.

Vecslir, Lorena and Pablo Ciccolella. 2011. "Relocalización de las actividades terciarias y cambios en la centralidad en la Región Metropolitana." *Revista de Geografía Norte Grande* 49:63-78.

Velez-Guerra, Andres. 2005. "Land tenure and the urban poor's environmental burdens: a case study of four settlememnts in Colombo, Sri Lanka." IDRC.

Villasante, Martin Rodrigo. 2008. "Agua potable en cuestión." in *La Nacion*. Buenos Aires.

Walker, Gordon, Gordon Mitchell, John Fairburn, and Graham Smith. 2005. "Industrial pollution and social deprivation: Evidence and complexity in evaluating and responding to environmental inequality." *Local Environment* 10:361-377.

Wang, Quan, Jian Ni, and John Tenhunen. 2005. "Application of a geographically-weighted regression analysis to estimate net primary production of Chinese forest ecosystems." *Global Ecology and Biogeography* 14:379-393.

Ward, Peter. 1998. *Mexico City*: John Wiley & Sons.

—. 2009. "Unpacking residential segregation: the importance of scale and informal market processes." *Investigaciones Geográficas* 70:114-134.

Weinberg, Adam. 1998. "The environmental justice debate: A commentary on methodological issues and practical concerns." *Sociological Forum* 13:25-32.

Wong, David. 1995. "Aggregation effects in geo-referenced data." in *Practical handbook of spatial statistics*, edited by S. Arlinghaus. Boca Raton: CRC Press.

Woodlief, Anthony. 1998. "The path-dependent city." *Urban Affairs Review* 33:405-437.

World Health Organization. 2005. "Ecosystems and human well-being : Health synthesis. A report of the Millennium Ecosystem Assessment." WHO.